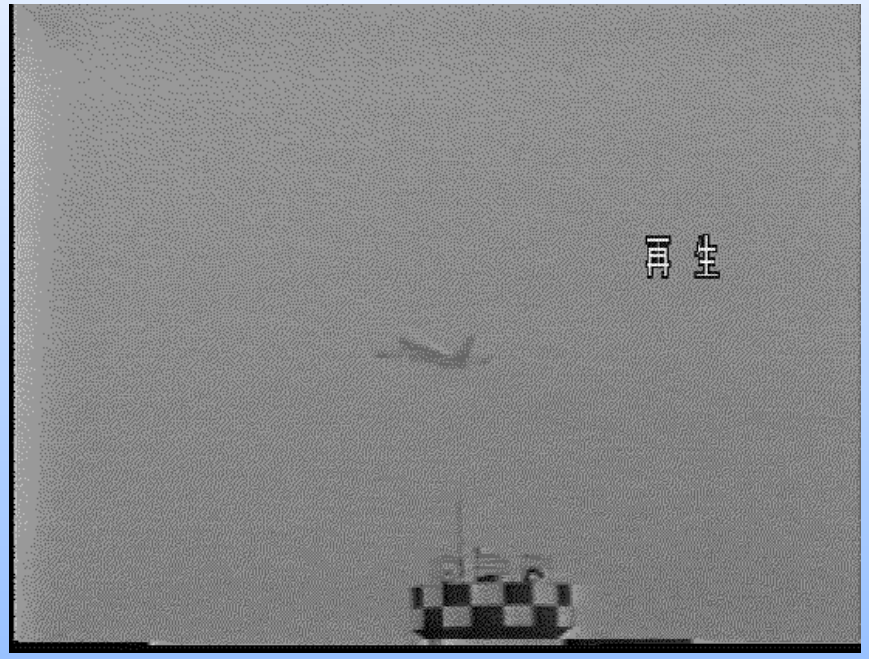
Nowcast

The Navy and Marine Corps Corporate Laboratory

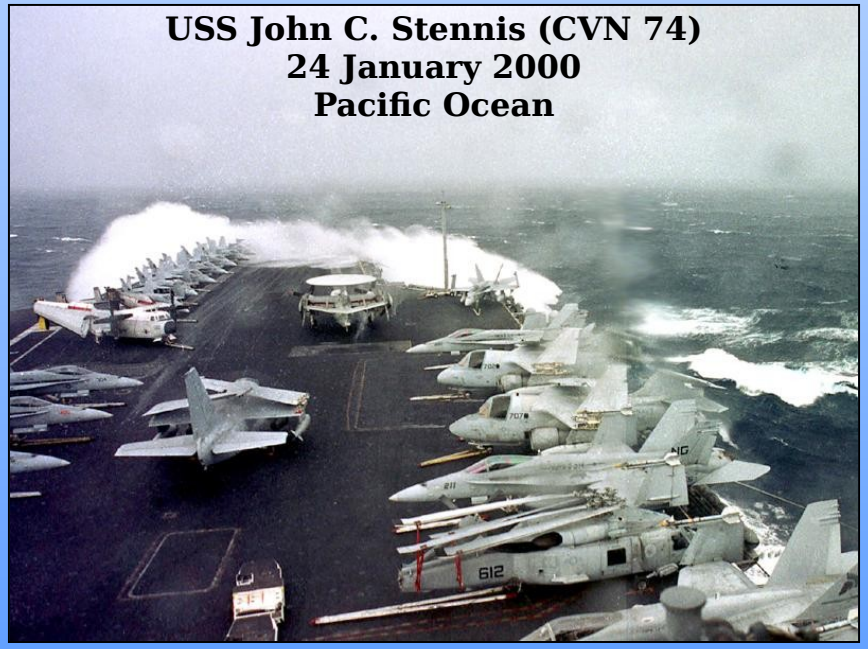


NRL

Linda Frost
Mike Frost
Dan Geiszler
Daren Grant
Craig Kunitani
Rosemary Landa
Yuehong Liao
Gary Love
Ramesh Mantri
Larry Phegley
Jennifer Strahl
Marie White
Allen Zhao

NCAR

Bruce Carmichael
Cathy Kessinger
Frank Hage
Martha Limber
Paddy McCarthy
Kevin Petty
Melissa Petty
Rita Roberts
Tom Warner
Gerry Wiener



Agenda

Nowcast 6.2 Review

Data Assimilation

1:00 - 1:15	COAMPS-OS/SPAWAR Horizontal Integration	John Cook (NRL)
1:15 - 1:30	ADAS/3D-VAR	Allen Zhao (NRL)
1:30 - 1:45	WxWeb	John McCarthy (NRL)

Data Fusion

1:45 - 2:00	Real-Time Verification	Rosemary Lande (NRL)
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2:40 - 2:50	Break	

System Architecture

2:50 - 3:05	Overview	John Cook (NRL)
3:05 - 3:25	Tier 1 and Demo	Marie White (Pangaea)
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3:40 - 4:00	Tier 3 and Tier 4	Mike Frost (CSC)

User Interaction

4:00 - 4:10	Buy-In	John McCarthy (NRL)
4:10 - 4:30	IPT	John McCarthy (NRL)

METOC Regional Model Operational Implementation Plan

FY98 — TEST AND EVALUATION

- NRL Monterey, CA
- NPMOF San Diego, CA

FY99 — INITIAL OPERATIONAL CAPABILITY

- NCMOC Bahrain
- FNMOC Monterey, CA
- NEMOC Rota, Spain

FY00 — FULL OPERATIONAL CAPABILITY

- NLMOC Norfolk, VA
- NPMOC Yokosuka, Japan
- NPMOC Pearl Harbor, HI
- Keesler AFB, MS

FY01

Other NRL Installations

- CIA
- NSWC Dahlgren
- DTRA
- US STRATCOM
- AFTAC
- NRL Data Fusion for Weather Assessment project (DaFWA)

CNMOC has designated FNMOC as the lead TAMS-RT transition activity

Navy Strategy for the Future

Telescoping Global/Regional/Tactical Systems

The Navy and Marine Corps Corporate Laboratory

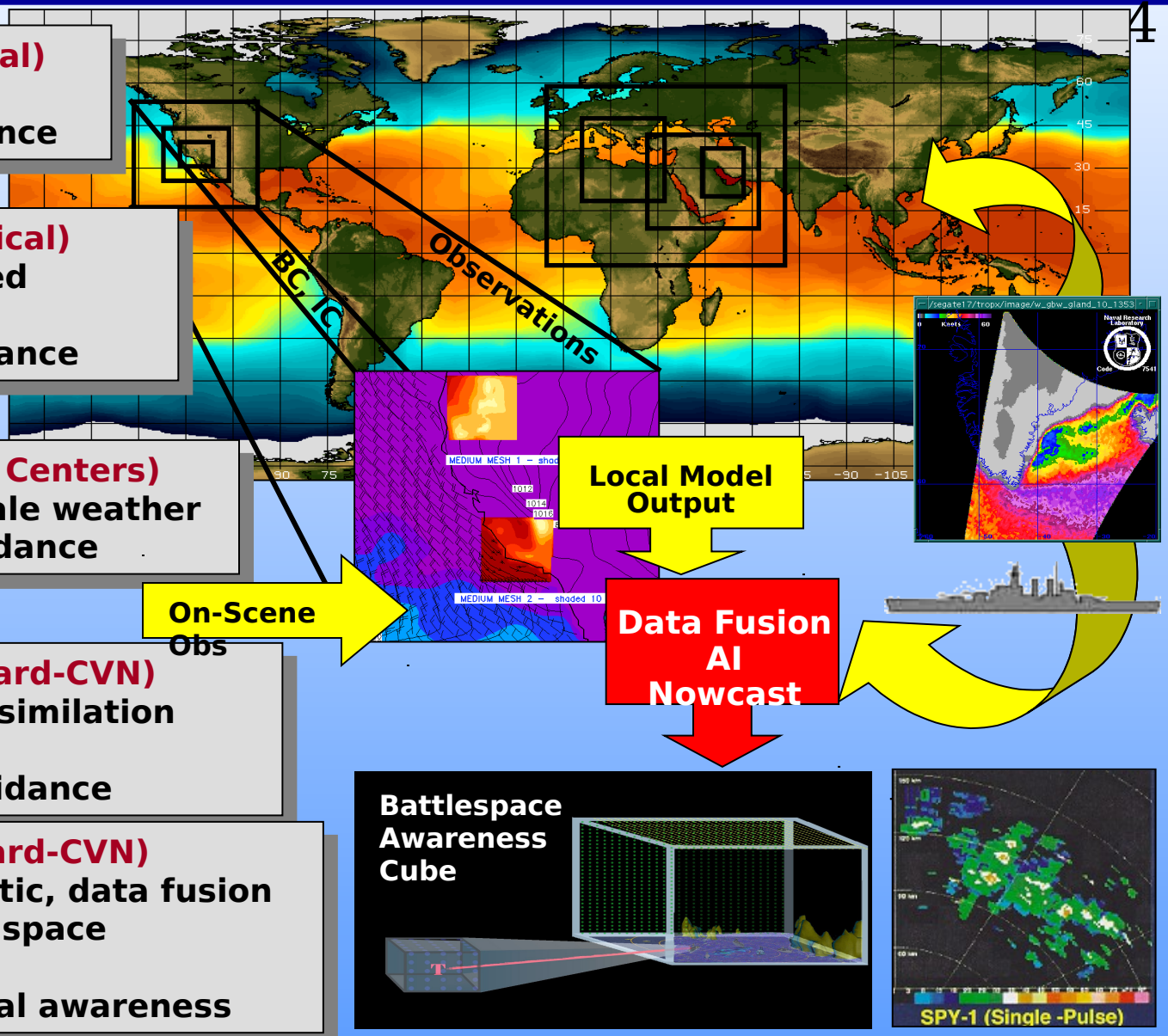
NOGAPS: (Fleet Numerical)
- Global coverage
- 1–10d forecaster guidance

COAMPS: (Fleet Numerical)
- High resolution, nested regional coverage
- 0-72h forecaster guidance

COAMPS-OS: (Theater Centers)
- On-scene tactical-scale weather
- 0-48h forecaster guidance

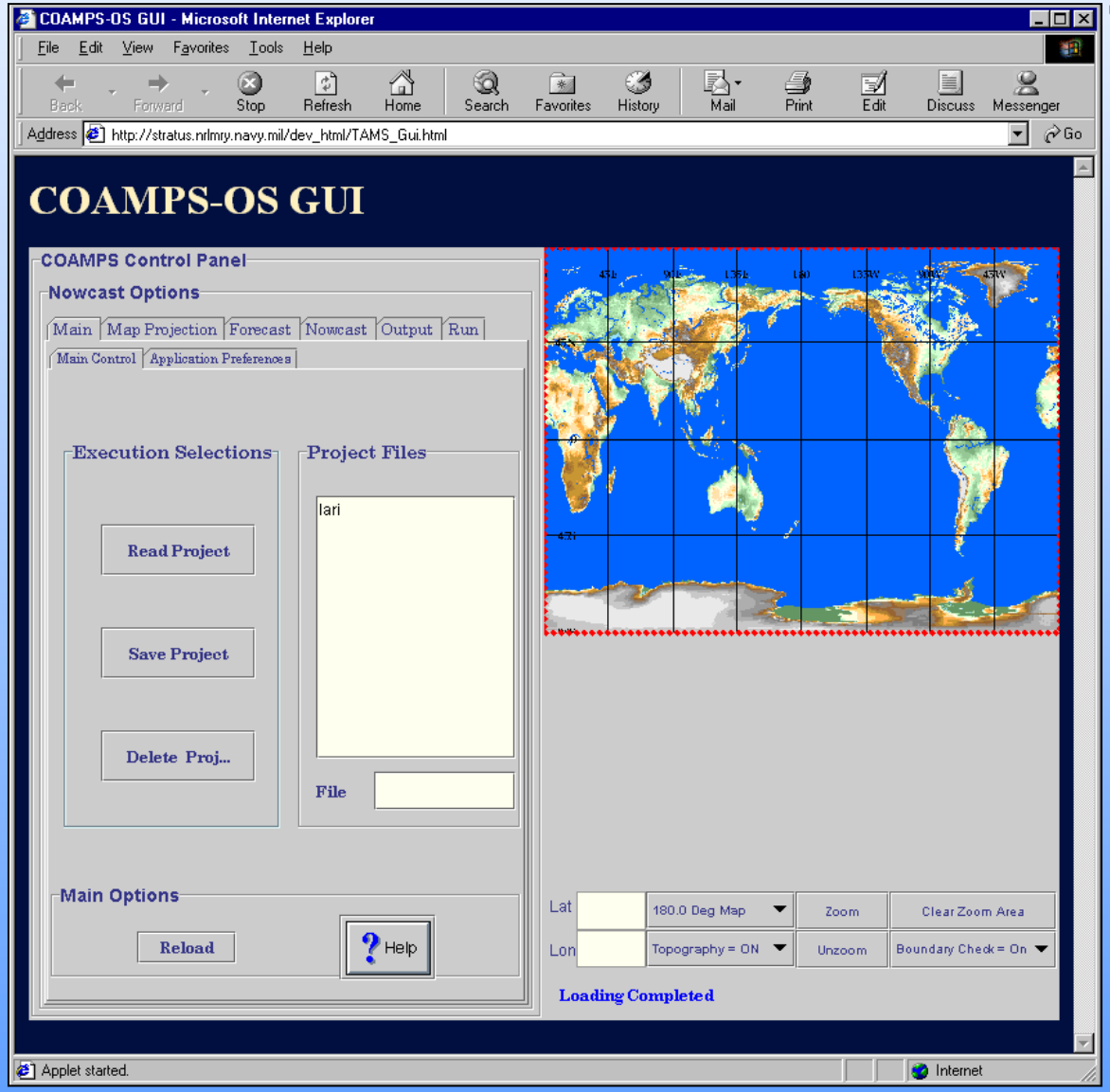
COAMPS-OS: (Shipboard-CVN)
- Battlegroup data assimilation system
- 0-24h forecaster guidance

NOWCAST: (Shipboard-CVN)
- Real-time, automatic, data fusion
- Warfighter time & space requirements
- Common situational awareness



COAMPS-OS

- Utilize NITES TEDS database and web server
- Web-based GUI
- 24 hr forecasts at 00Z and 12Z
- Hourly analyses
- 9 km resolution around ship position and target area
- 3500 km X 3500 km to 350 km X 350 km coverage



Architecture
COAMPS Processing Requirements

- Twice a day for 2 to 3 hrs each time
- Hourly for 5 - 10 min each time
- Sustained processing power of 4 to 6 CPUs
- Desired times at 03Z and 15Z for the COAMPS forecasts and hourly at 30 min past the hour for the analysis system
- 250 MB to 500 MB RAM
- Approximately 200,000 lines of code
- 10.5 GB disk
- Solaris 2.8 / DII COE 4.3

Implementation and fielding of this capability is dependent on the consolidated servers providing the required processing power

Lateral Boundary Condition Data Flow (per 12 h watch)

FNMOC

NOGAPS
- 1/8 global coverage

36 MB
(t=12, 18, 24, 30, 36, 42, 48, 54, 60 hr; 21 levels)

COAMPS
- Regional Coverage

97 MB

Compress 50%

METOC Center DAMPS/NITES I

NOGAPS
- 1/32 Coverage

9 MB
(t=12, 18, 24, 30, 36 hr; 21 levels)

COAMPS-OS
- Local coverage

17 MB

Compress 50%

Shipboard NITES I Afloat

24 hrs of boundary conditions provide fail-over for two 12 hr data assimilation cycles

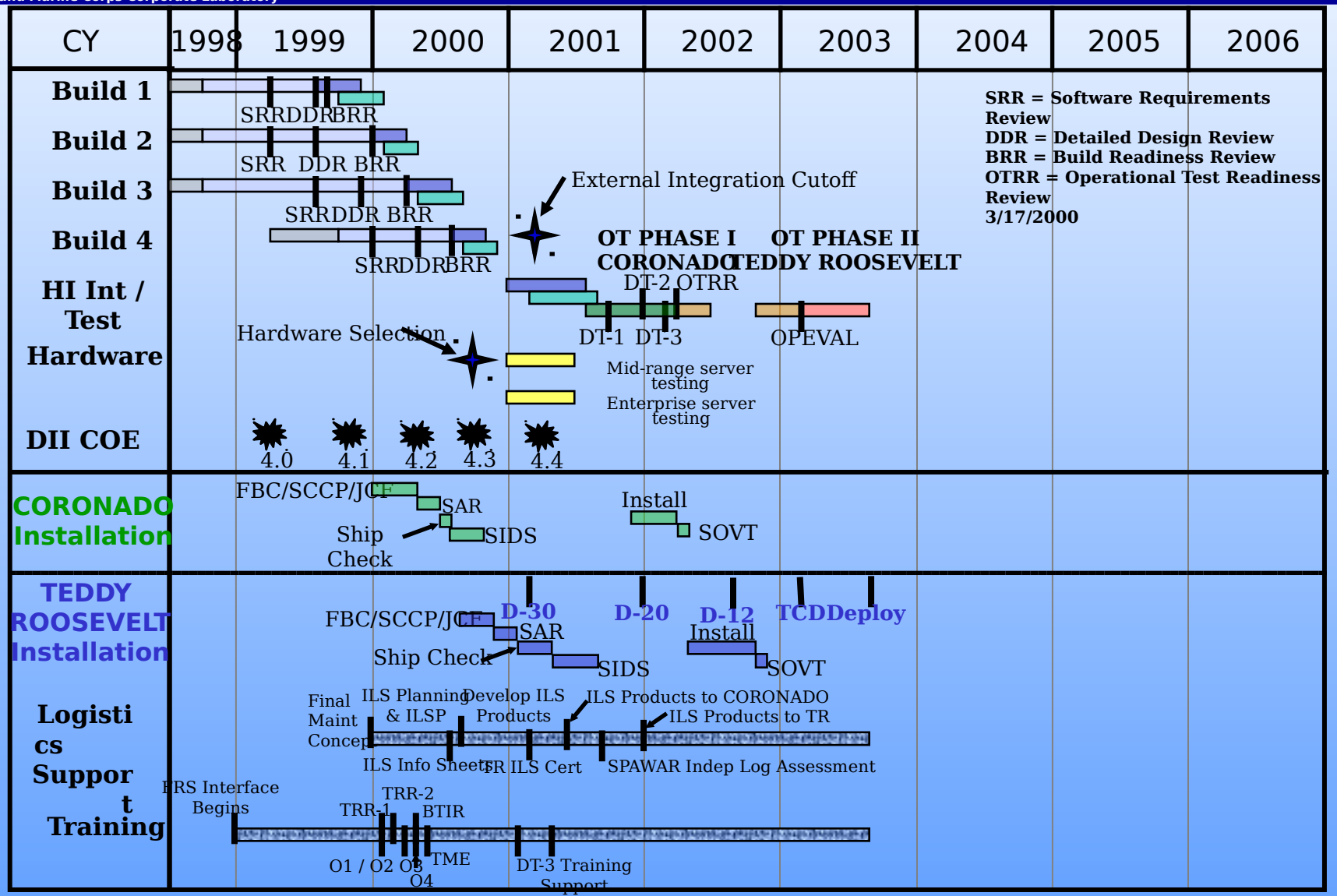
Estimated COAMPS-OS Shipboard Communications Requirements

Data	Kbits/ sec	Kbits/sec (Compressed)	Data Type	Frequency	Origin
Conventional FNMOC	0.083	(75%) 0.021	Alpha text	Continuous	or Center
Satellite FNMOC	0.356	(50%) 0.178	Binary BUFR	Continuous (30 min)	or Center
Moriah	0.279	(50%) 0.140	Binary	Continuous (5 min)	All Ships
	0.718	0.339			
NOGAPS LBC (45 X 45 deg) FNMOC	20.62	(50%) 10.31	Binary GRIB	Twice a day (1 hr)	or Center
	21.338	10.65			

COAMPS-OS Requirements
10.65 kbits/sec (compressed)
twice a day for 1 hour duration

SPAWAR HI / 4.X Build Plan

The Navy and Marine Corps Corporate Laboratory



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NRL Cloud Analysis for NOWCAST

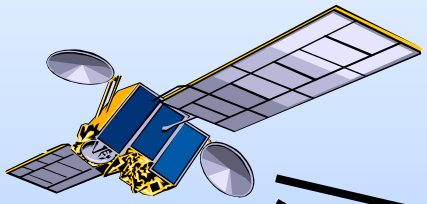
NOWCAST Team

Naval Research Laboratory Marine Meteorology Division
Monterey, California

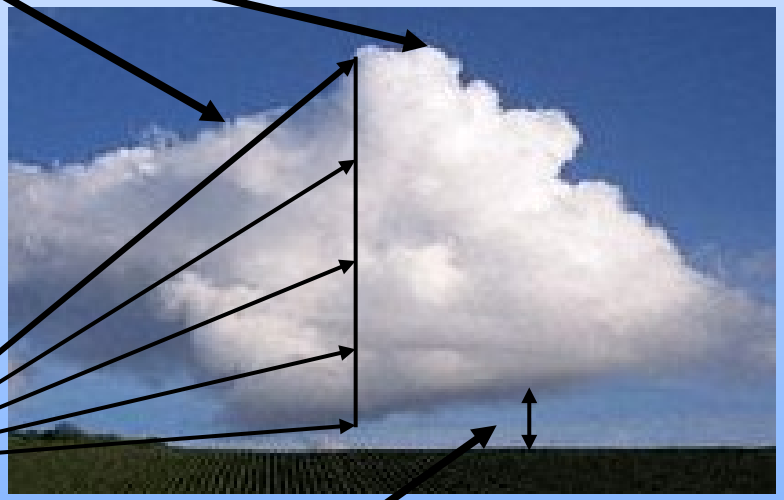
Other People involved:

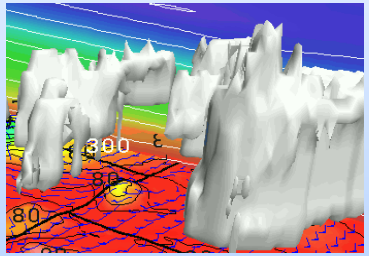
Keith Sashegyi (NRL, PI, ONR 6.2-RADAR)
Qin Xu (NSSL/NOAA), Li Wei (Univ. of Oklahoma)
Joseph Turk (NRL, Satellite Data)
Sue Chen and Jerry Schmidt (NRL, Coamps System)

Cloud Analysis System



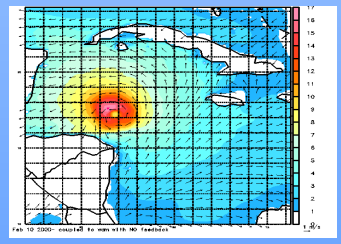
Satellite



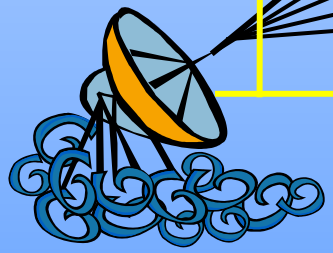


3D Clouds

Cloud Analysis System



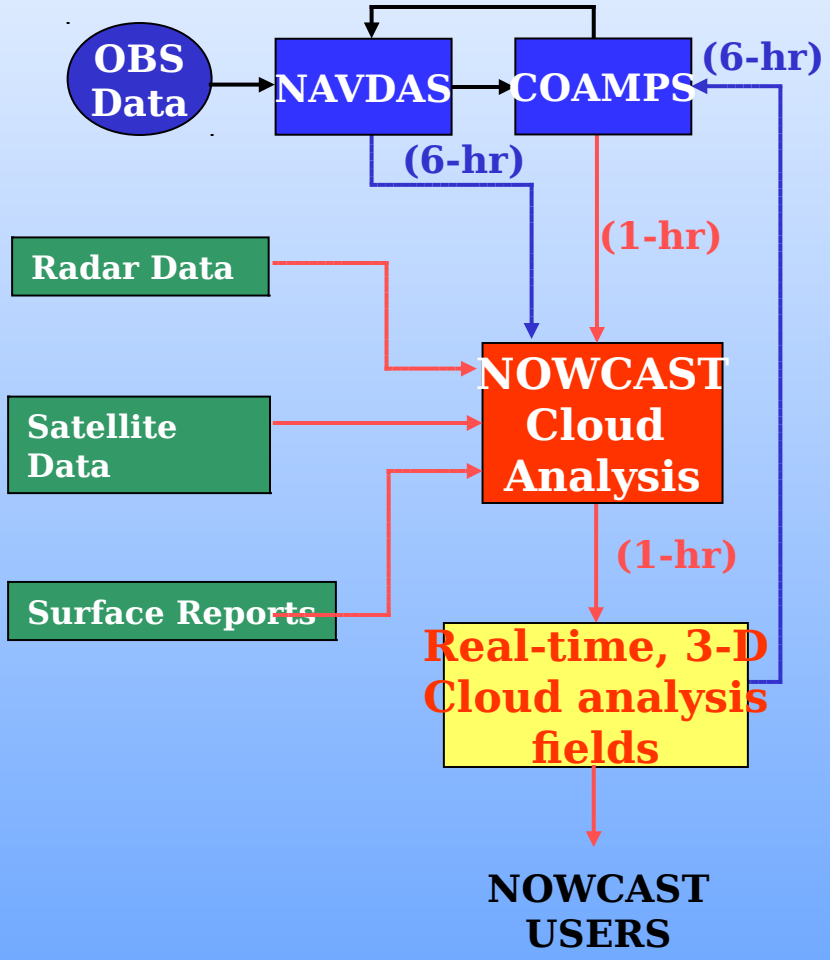
Model Forecasts



Radar

Surface Observations

NRL NOWCAST Cloud Analysis



- The NOWCAST Cloud Analysis System is operationally running every hour on a SGI workstation, using COAMPS hourly forecasts as background fields and fusing satellite brightness temperature and albedo data to provide real-time, three-dimensional cloud analysis fields for the NOWCAST users.
- ADAS products include:

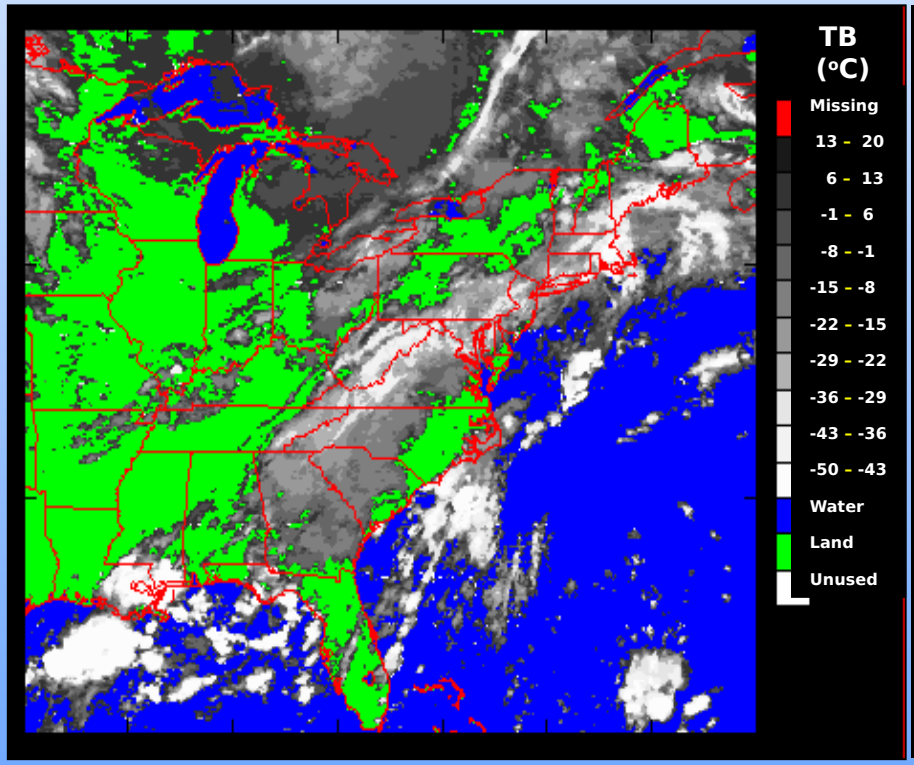
  3-D fields: cloud water mixing ratio, cloud ice mixing ratio, rain water mixing ratio, and snow mixing ratio.

  2-D fields: cloud top height, cloud top temperature, cloud base height, ceiling, and horizontal visibility.
- The surface observations are being extracted from the TEDS

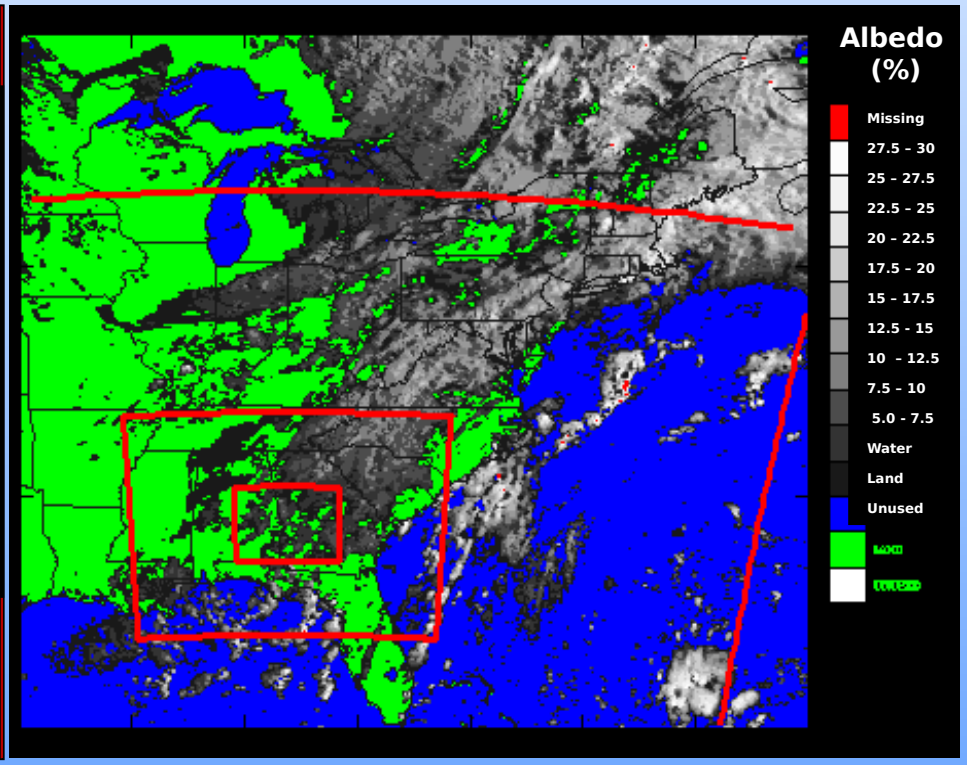
Satellite Image of Brightness Temperature (°C) and Albedo (%)

12 Z August 3, 2000

Brightness Temperature



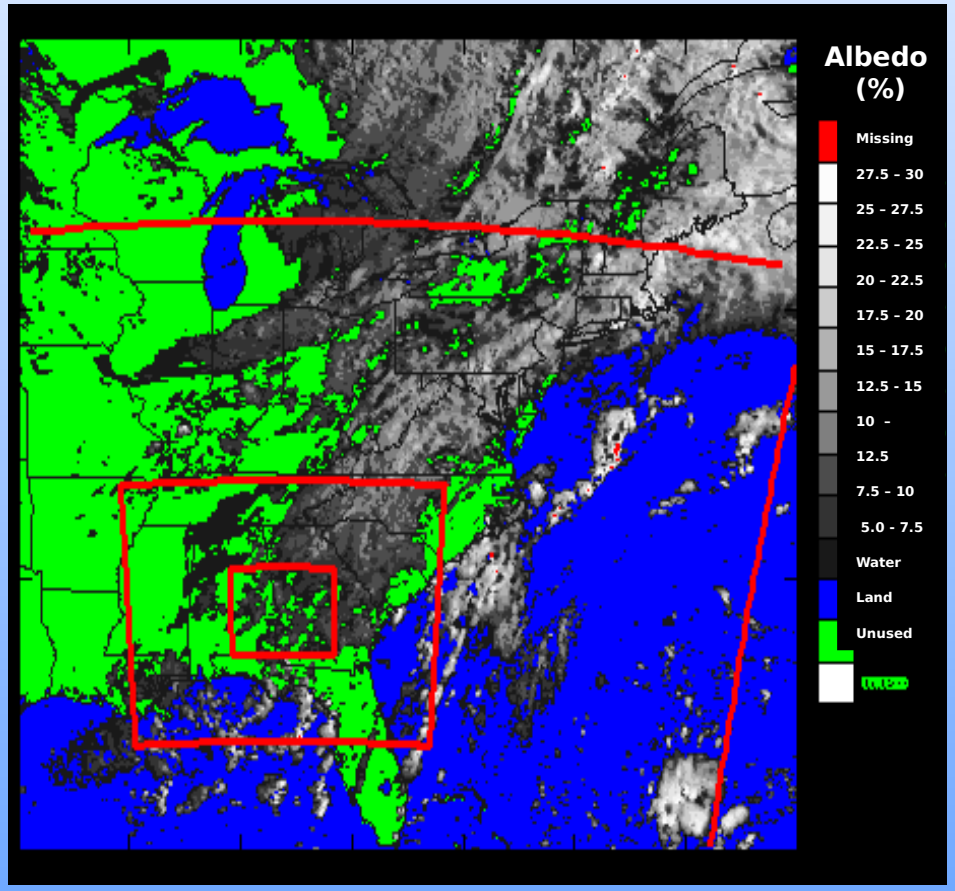
Albedo



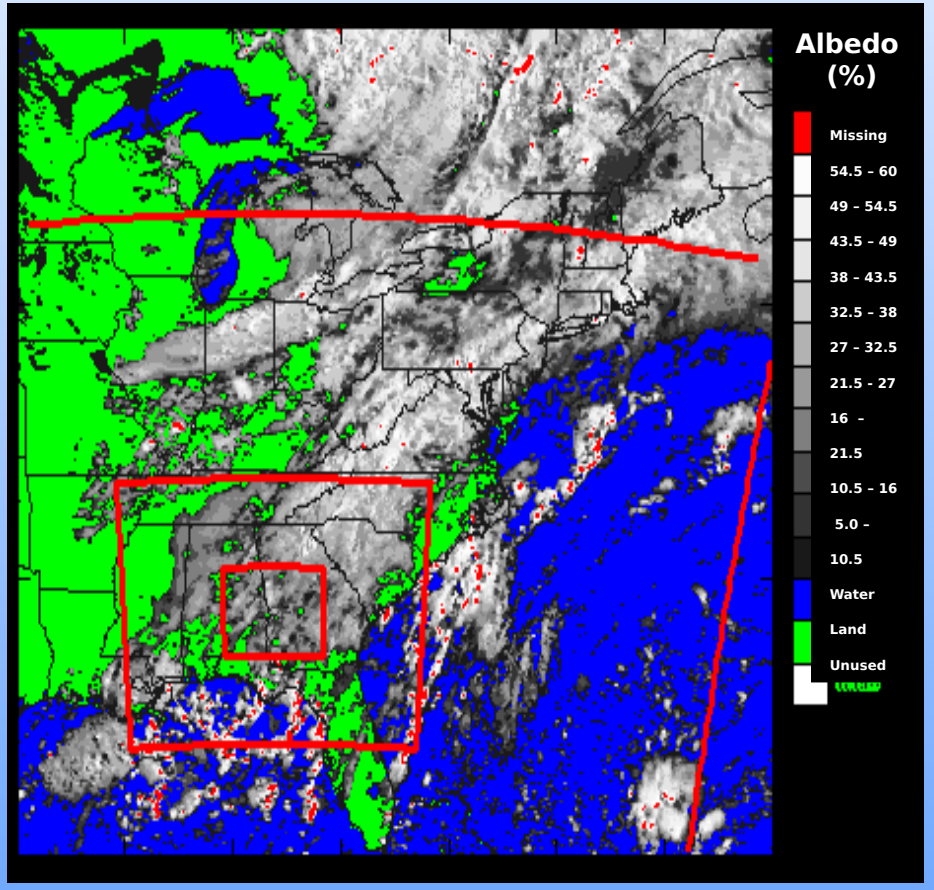
Satellite Image of Albedo (%) Before and After Adjustment

12 Z August 3, 2000

Before Solar Angle Adjustment

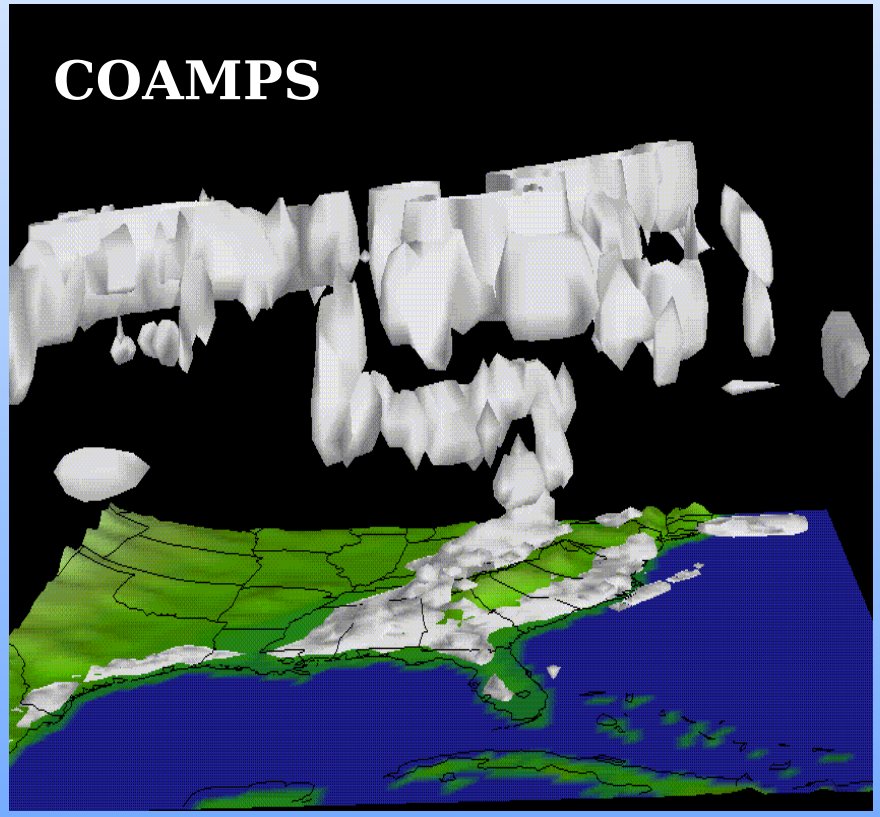


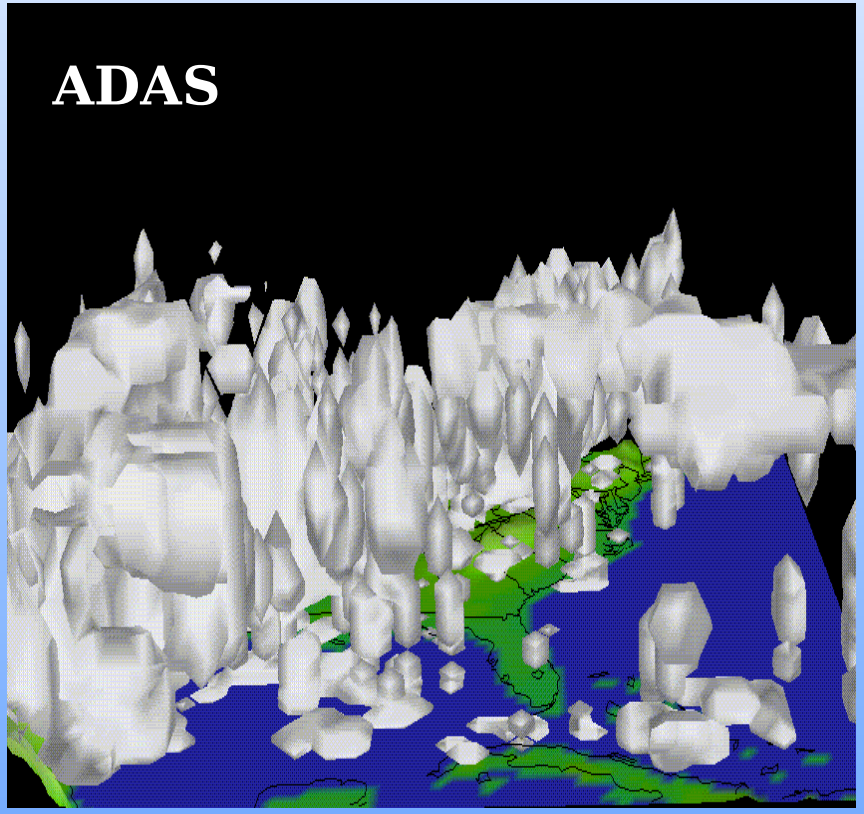
After Solar Angle Adjustment



3-D Clouds from ADAS Cloud Analysis and COAMPS forecast

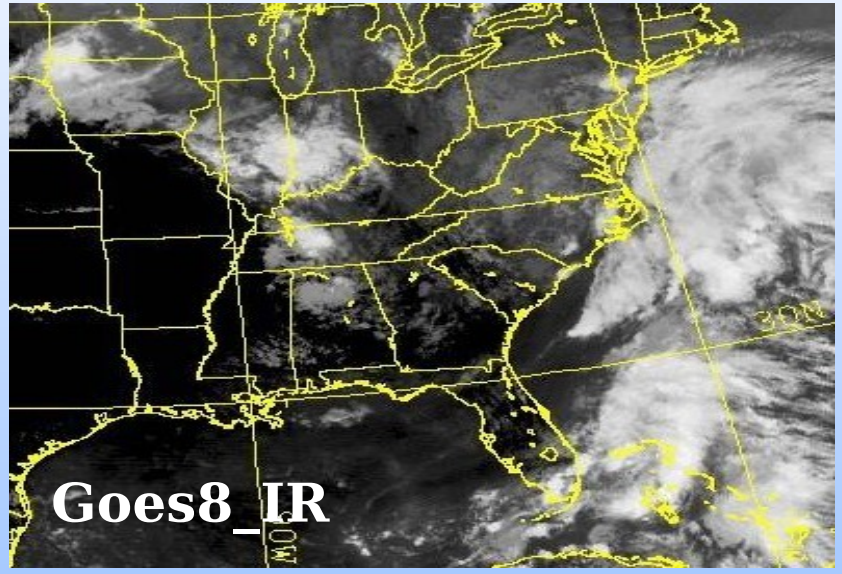
12 Z August 3, 2000

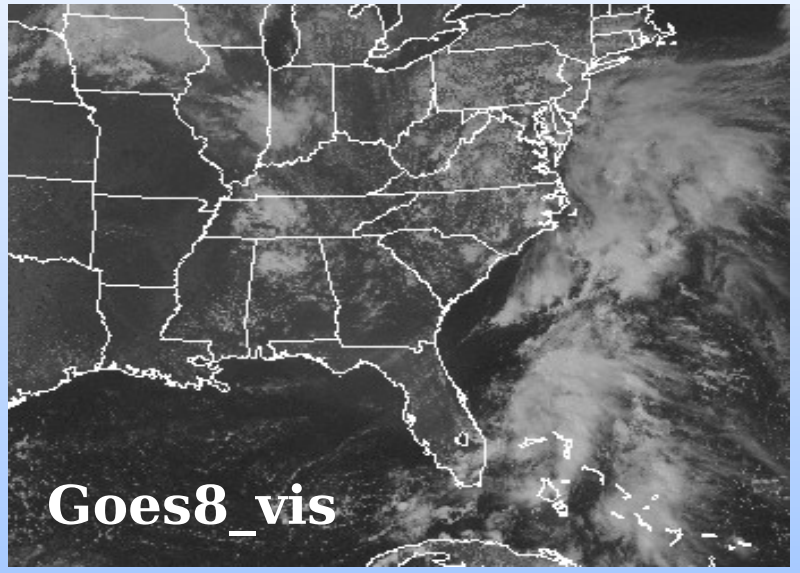


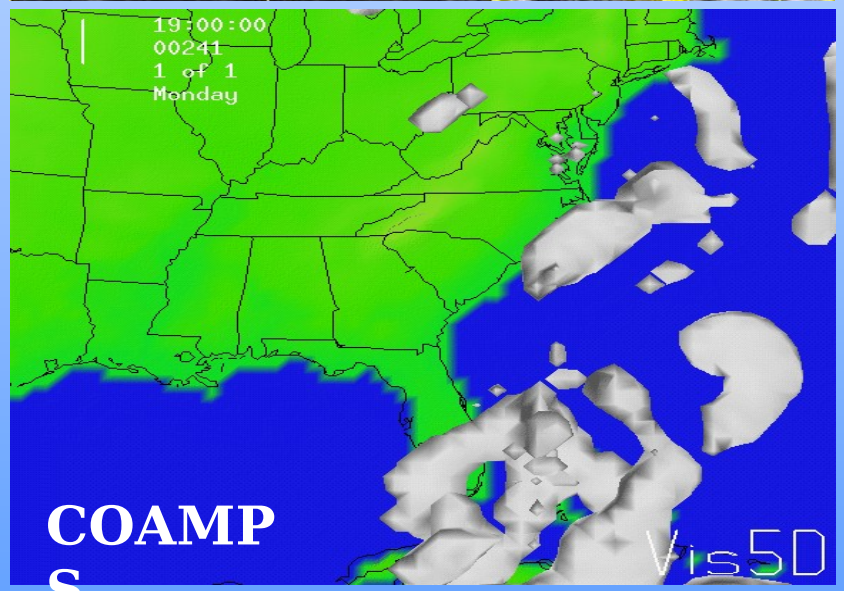


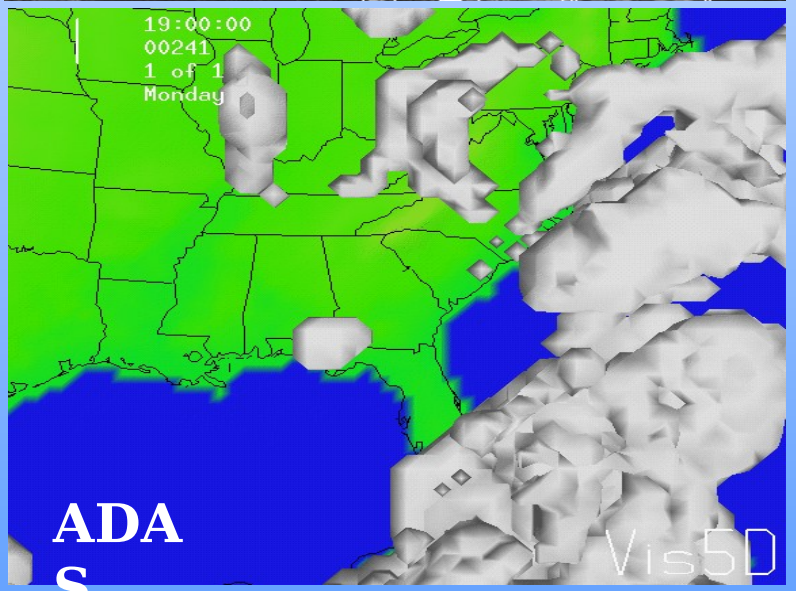
Satellite Images and 3-D clouds from ADAS and COAMPS

197 August 28, 2000





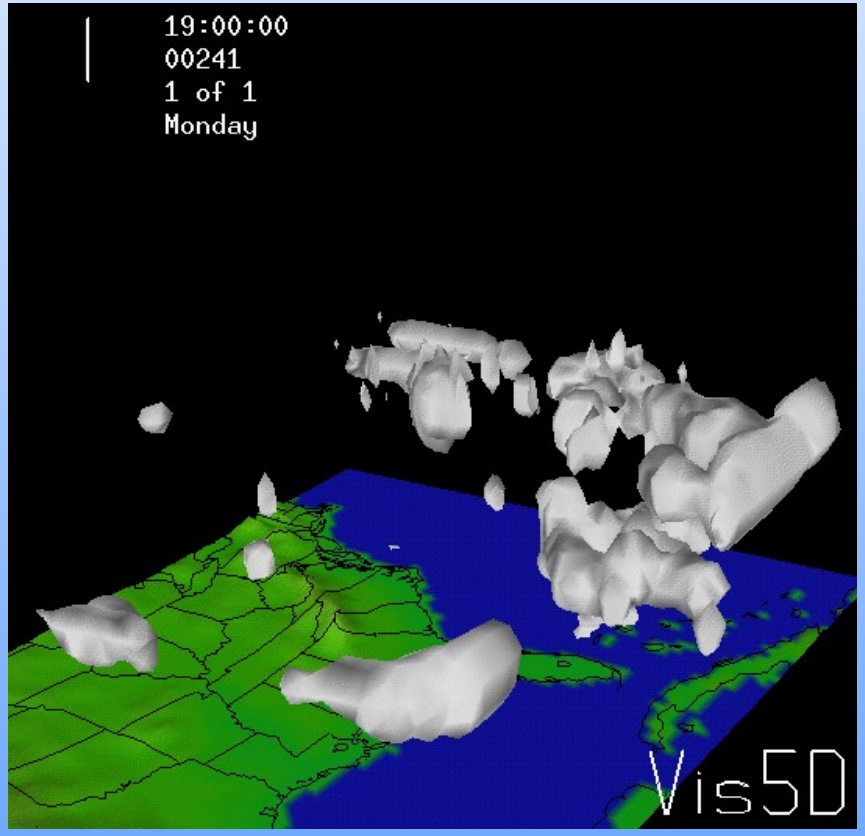




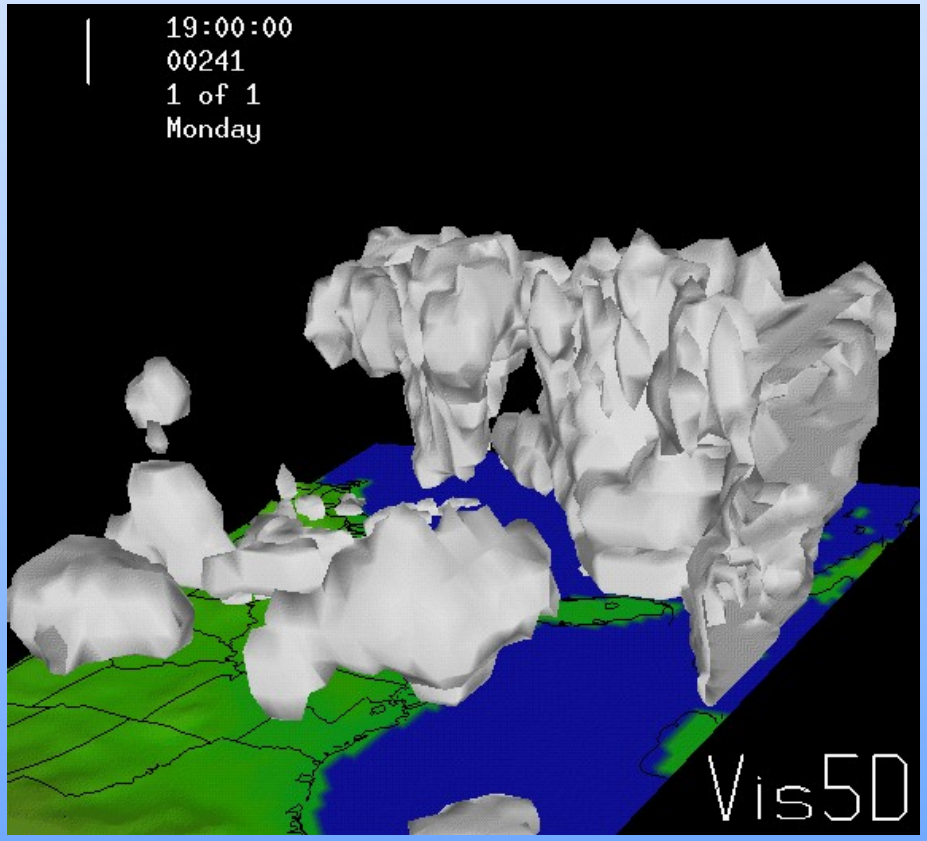
Three-dimensional view of the 3-D clouds from ADAS and COAMPS

19Z August 28, 2000

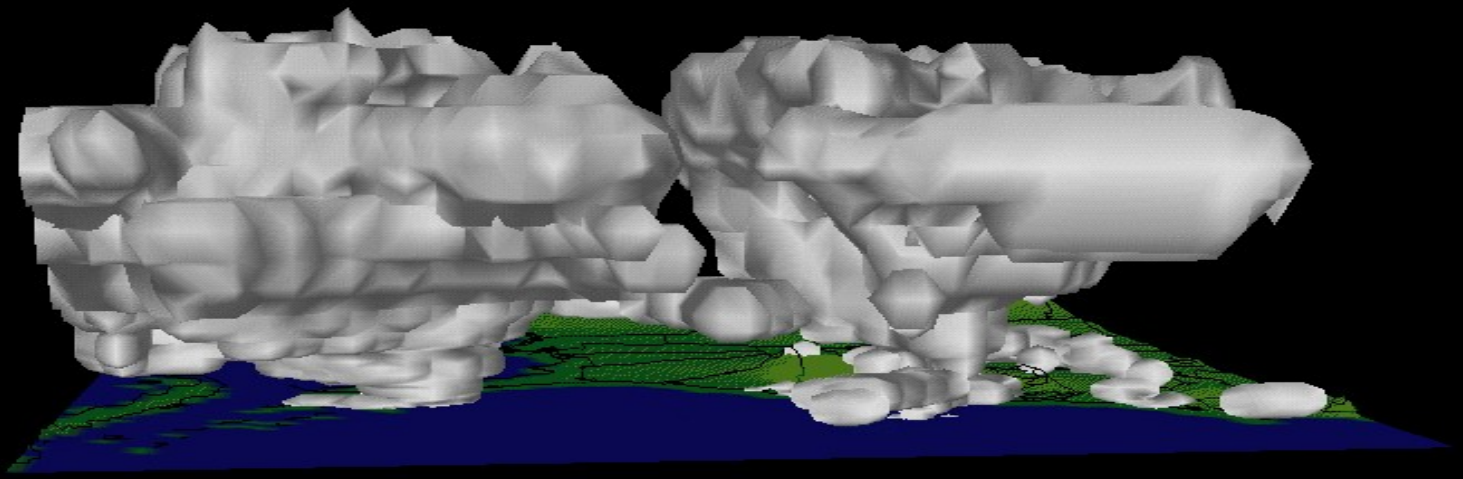
From COAMPS cloud forecast



From ADAS cloud analysis



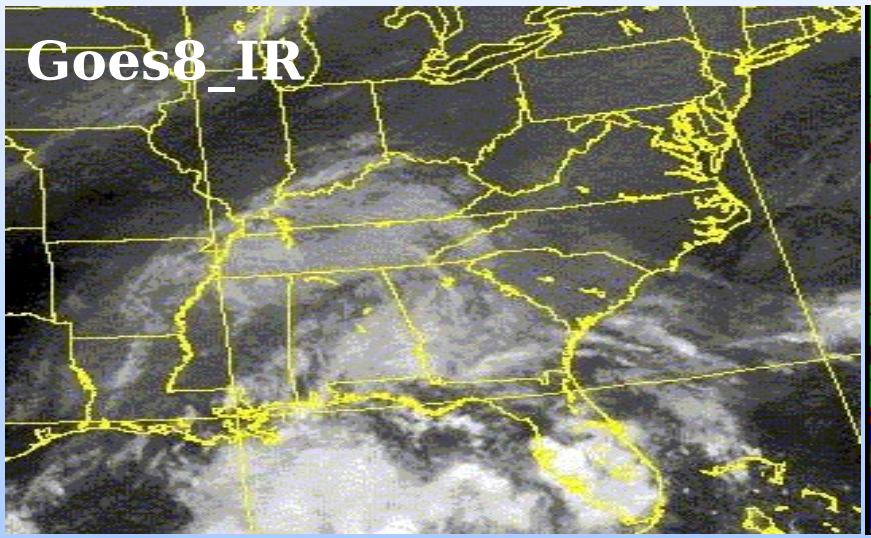
18:00:00
00241
1 of 12
Monday

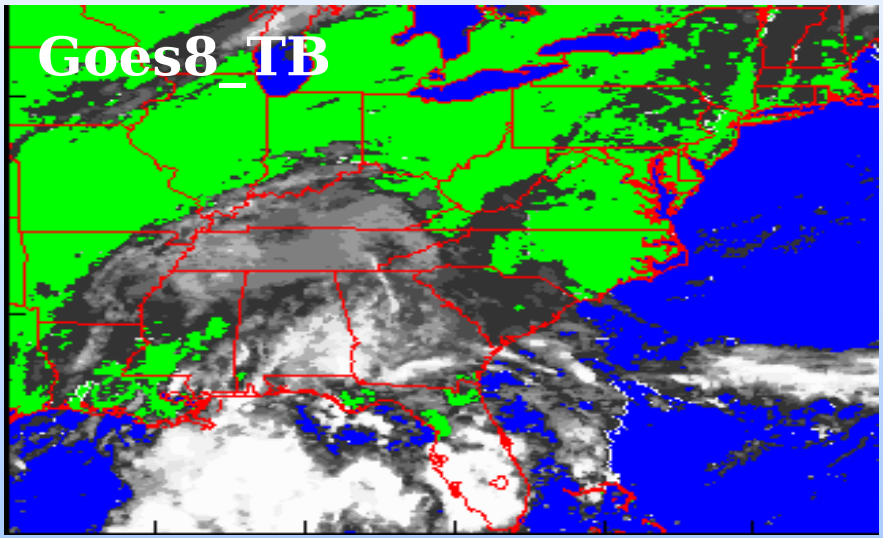


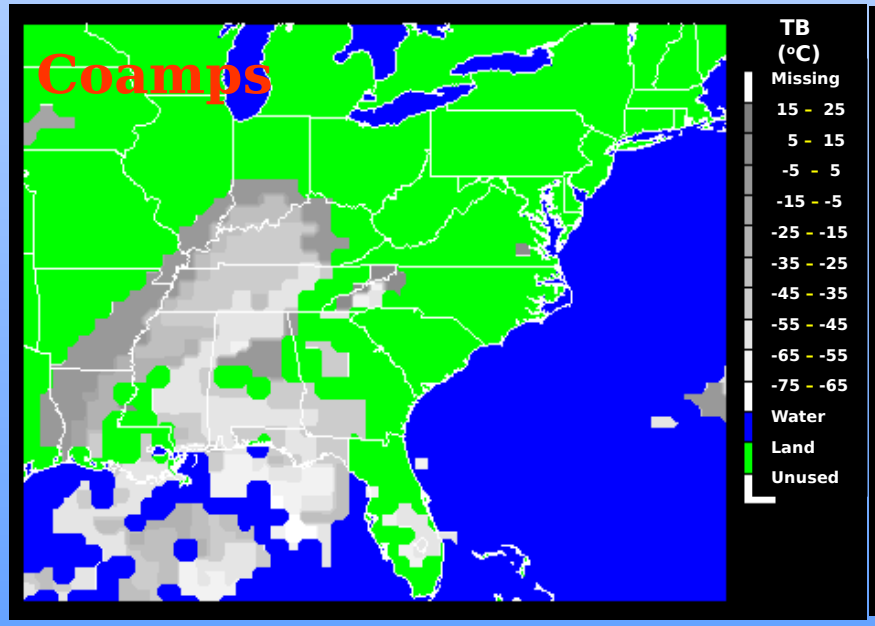
Vis5D

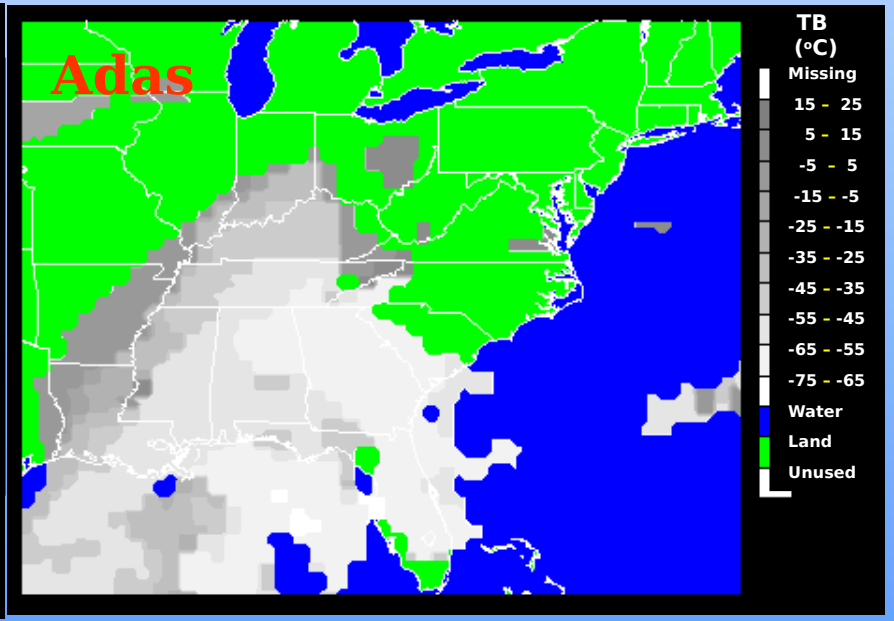
Cloud Top Temperature from Satellite Observations, Coamps Forecast, and ADAS Analysis

00Z September 8, 2000









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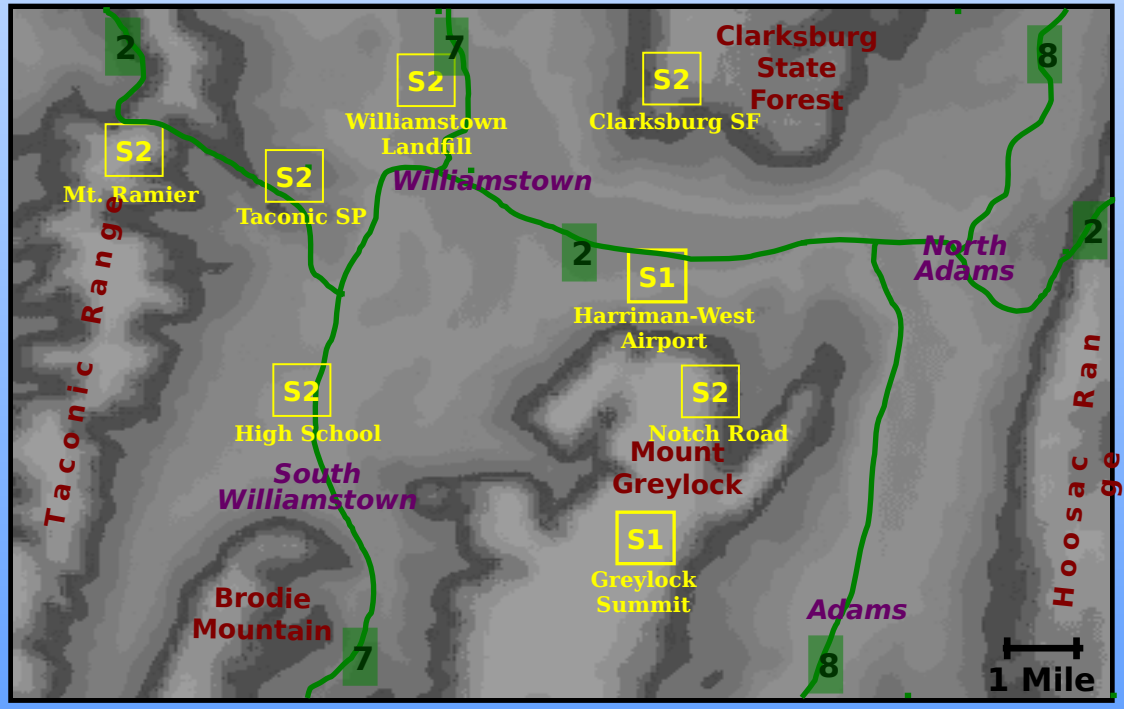
Smart SensorWeb
The "6th Sense" for the Battlefield

The Navy and Marine Corps Corporate Laboratory

Joint Vision 2025: Complete Situational Awareness

- InfoWeb and Integration Testbed
- ImageWeb
- WeaponsWeb
- WeatherWeb
  - Testbed set up in NW Mass. Oct 99

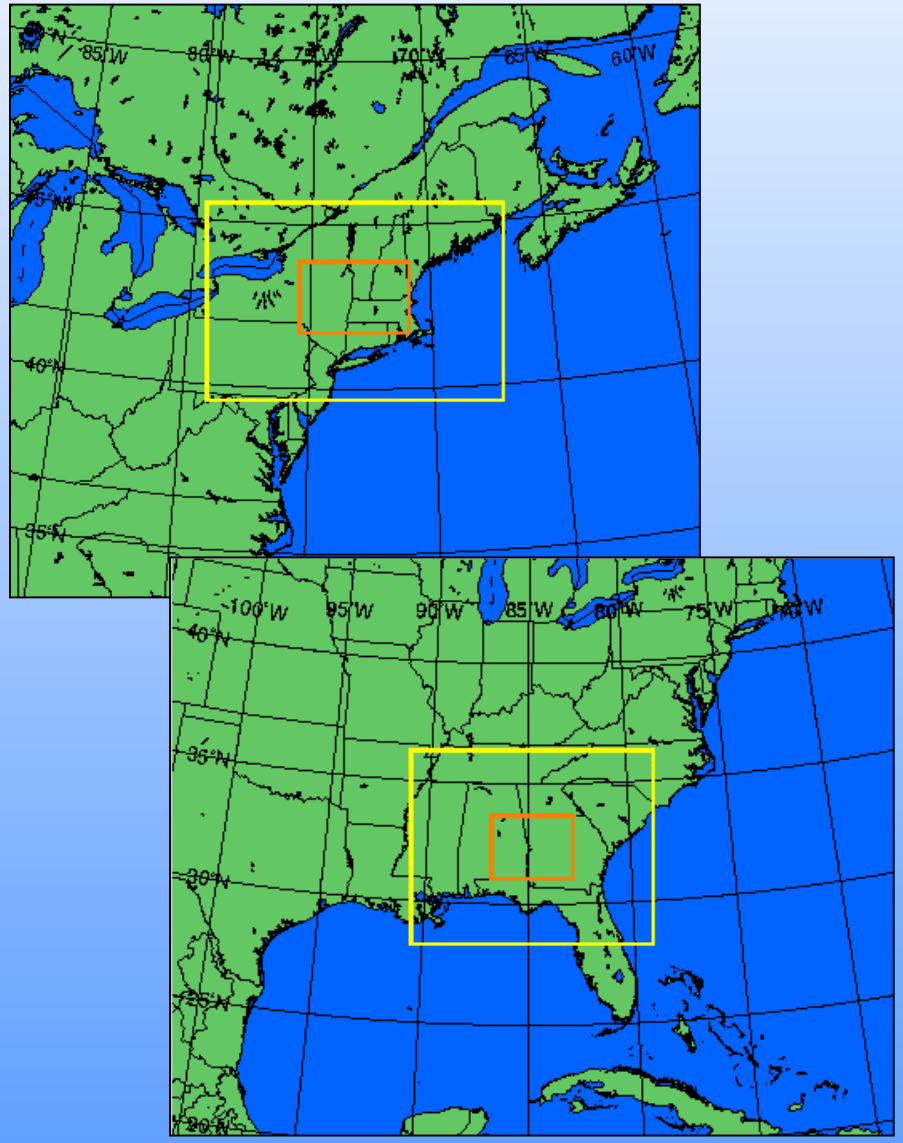


WeatherWeb Testbed

S&T Thrusts:

- Coordinate DARPA/Service efforts
- Pursue joint programs to address technology gaps
- Evolve "Web-Centric" capabilities via testbeds

COAMPS-OS Support



Greylock

- Center: 42.70 N 73.17 W
- Coarse: 43 X 37 54 km
- Medium: 55 X 37 18 km
- Fine: 61 X 40 6 km
- 12 hr forecast
- 11Z and 23Z; 3 hrs to run

MOUT

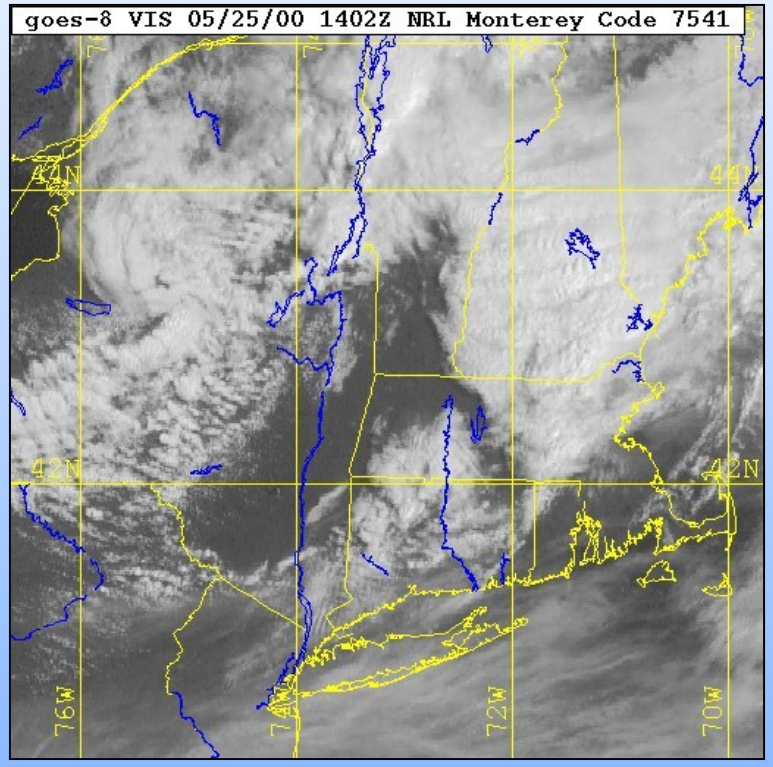
- Center: 32.37 N 84.81 W
- Coarse: 61 X 49 54 km
- Medium: 61 X 49 18 km
- Fine: 61 X 49 6 km
- 48/24 hr forecasts
- 3Z and 15Z; 7 hrs to run

Ft. Benning MOUT Sensors

- Sensor locations
- Transmit data once an hour containing 1 min obs
- Ingested into TEDS and extracted for use by MVOI and Nowcast (Nowcast format is the same as NAVDAS)

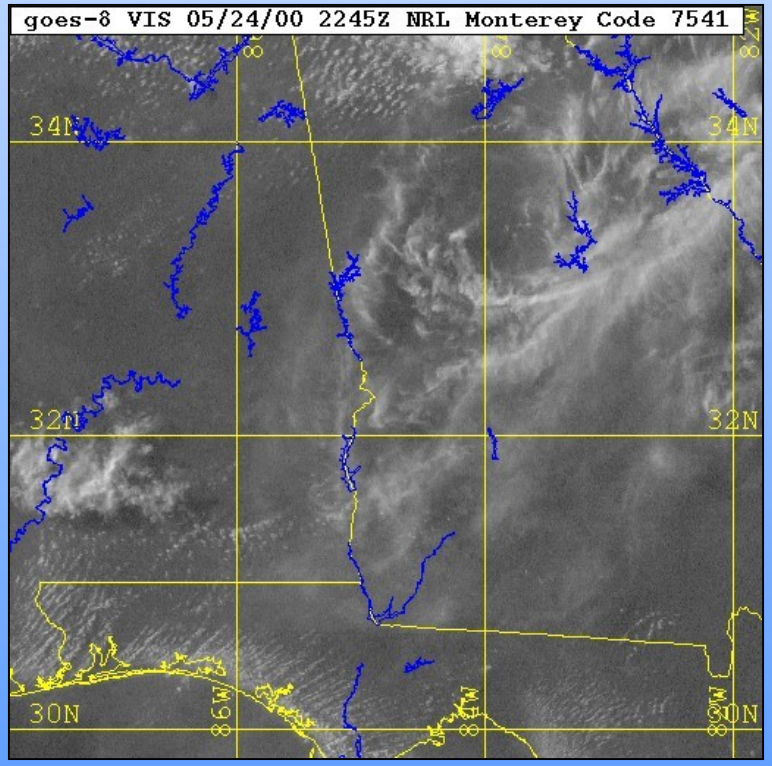
Satellite Pages

http://kauai.nrlmry.navy.mil/sat-bin/conus.cgi

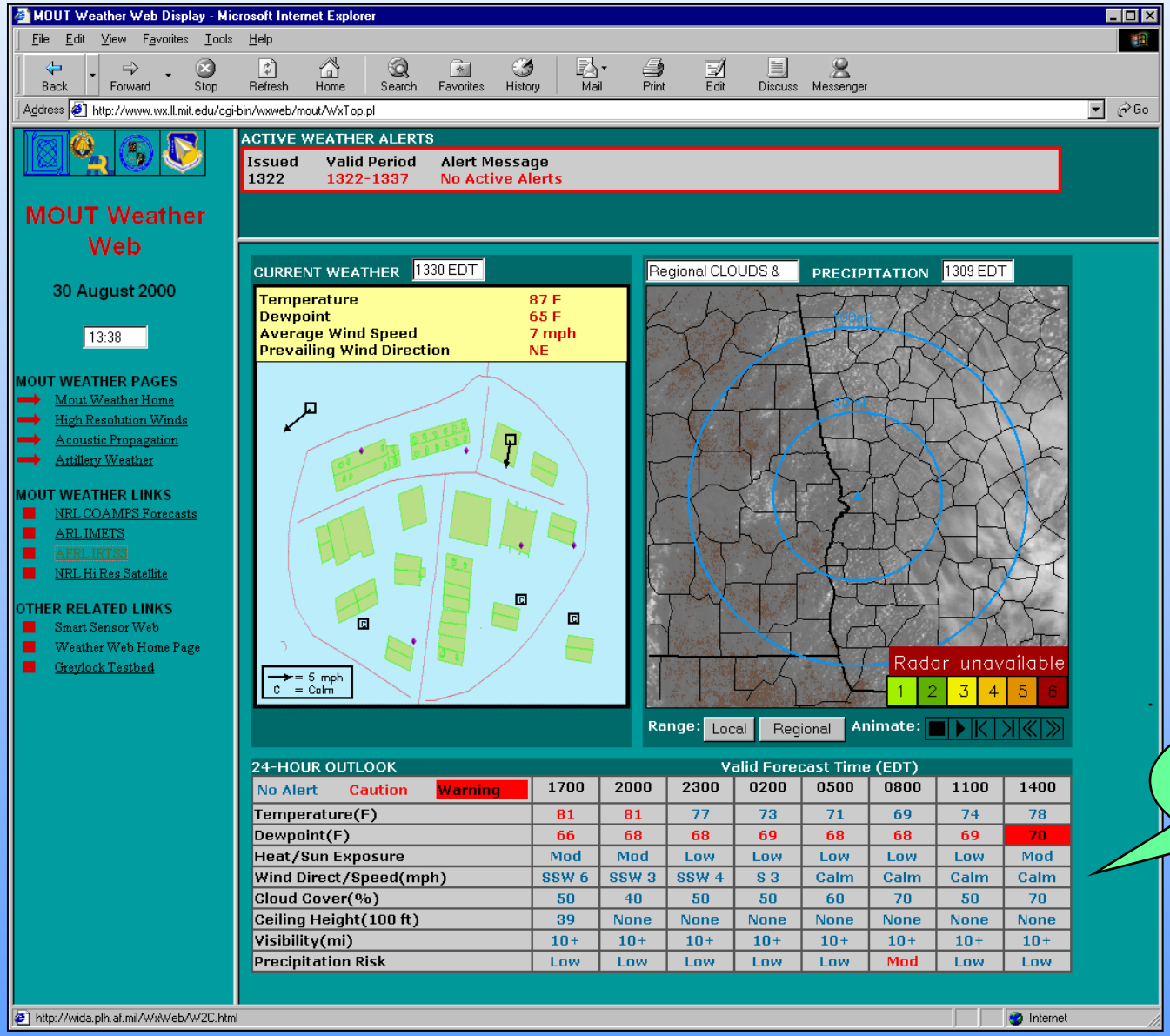


Greylock

MOUT



Ft. Benning MOUT Site



COAMPS forecast data

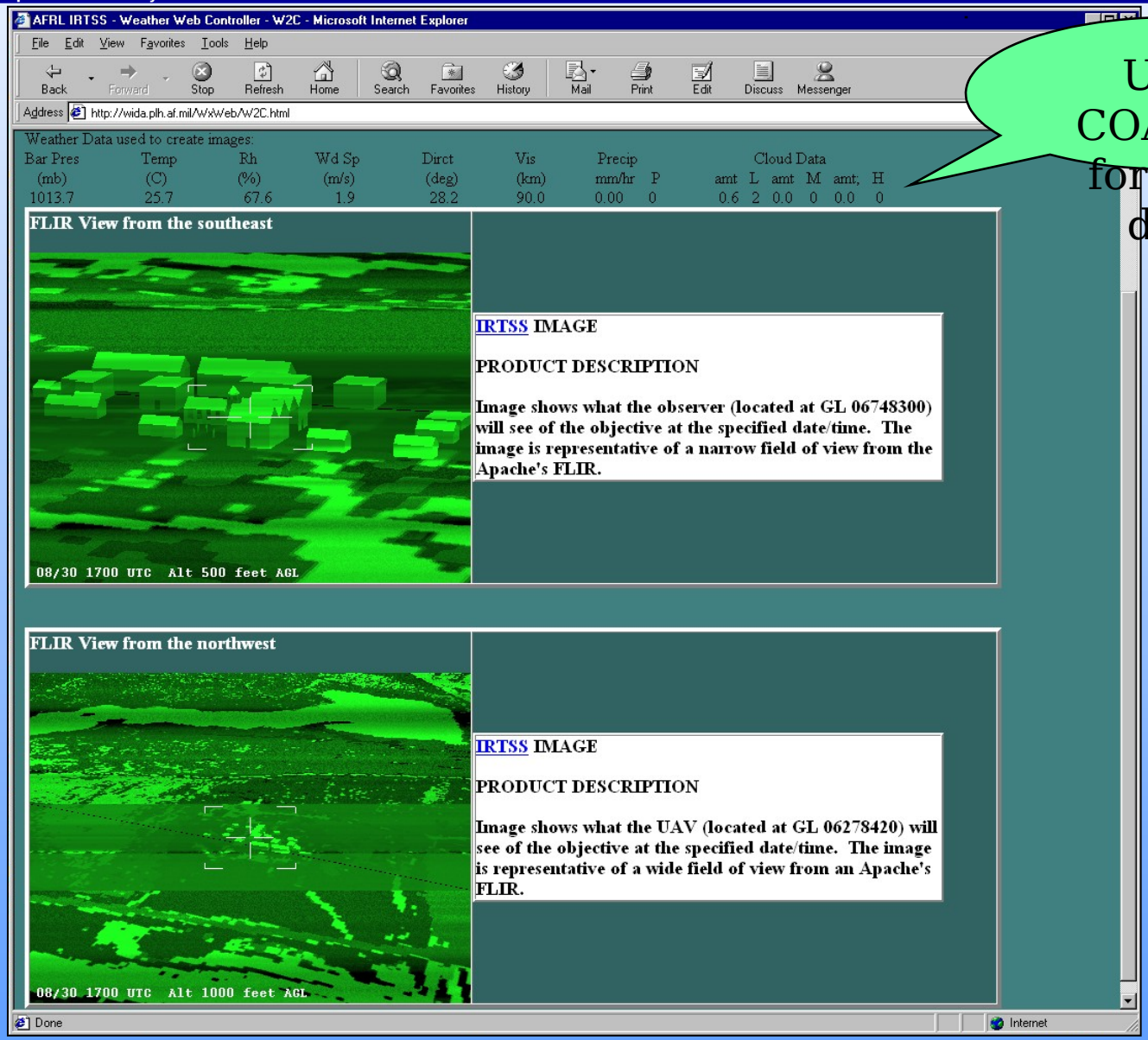
COAMPS Files on the Web

ftp://ftp.nrlmry.navy.mil/receive/cook

COAMPS flat files (hourly) available on ftp site supporting WxWeb home page and Air Force Infrared Target Scene Simulation (IRTSS) model

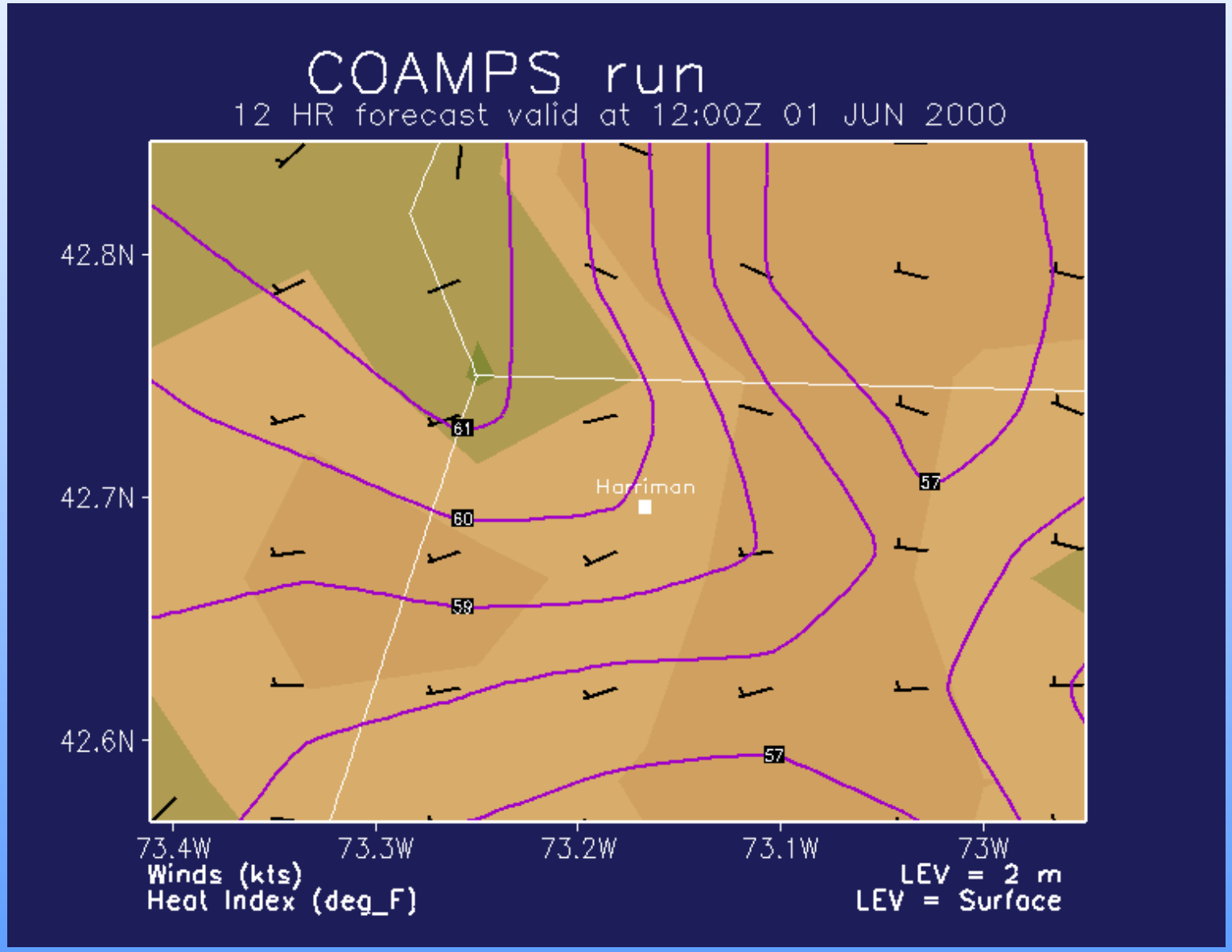
- Air Temperature
- U and V Wind Components
- Heights
- Relative Humidity
- Sea Level Pressure
- Cloud Base Height
- Net Incoming Solar Radiation
- Precipitation
- Cloud Ceiling Height (NCAR)
- Visibility (NCAR)
- Cloud Coverage
- Topography, Latitude, Longitude, Land/Sea Table

Air Force IRTSS Product

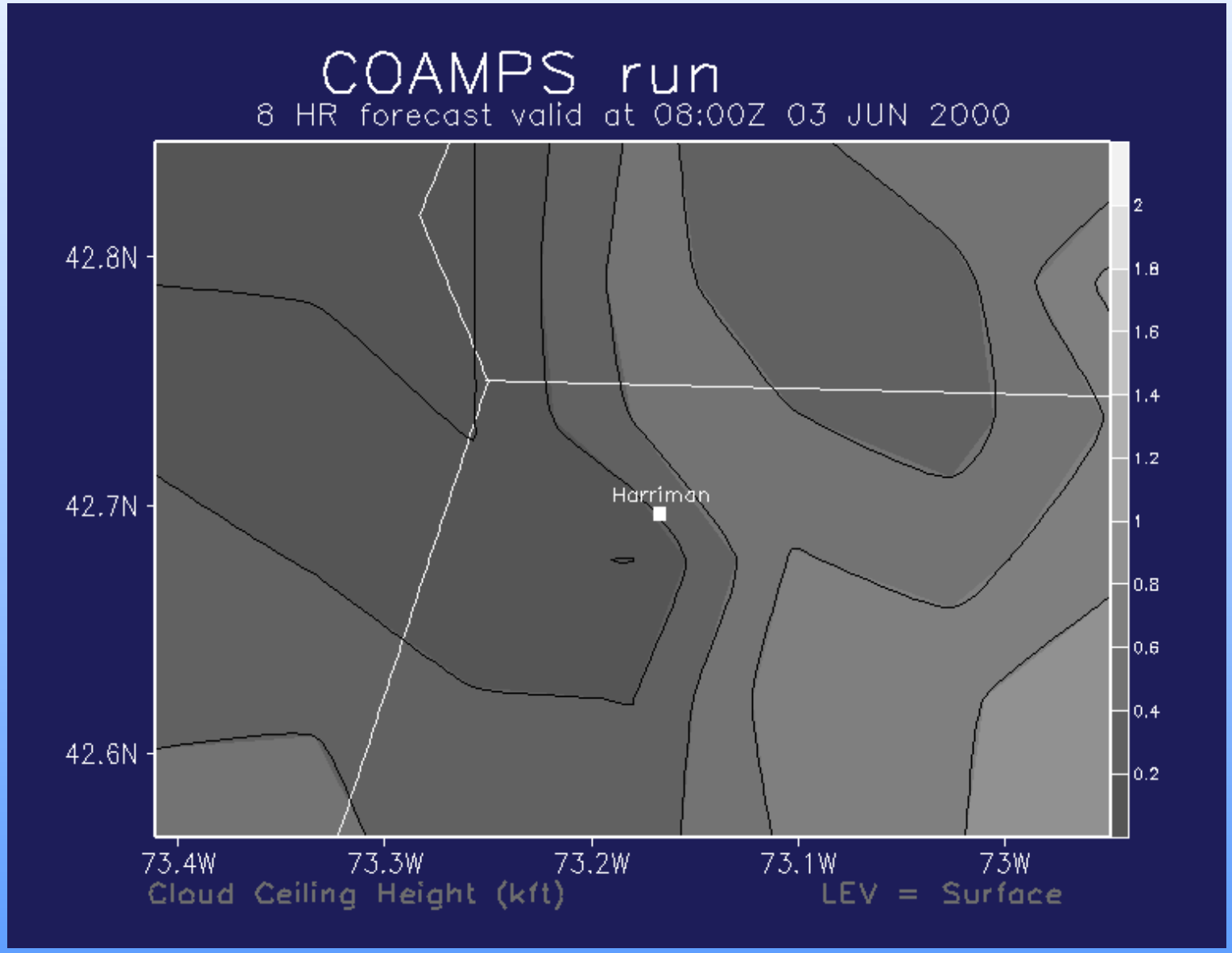


Uses COAMPS forecast data

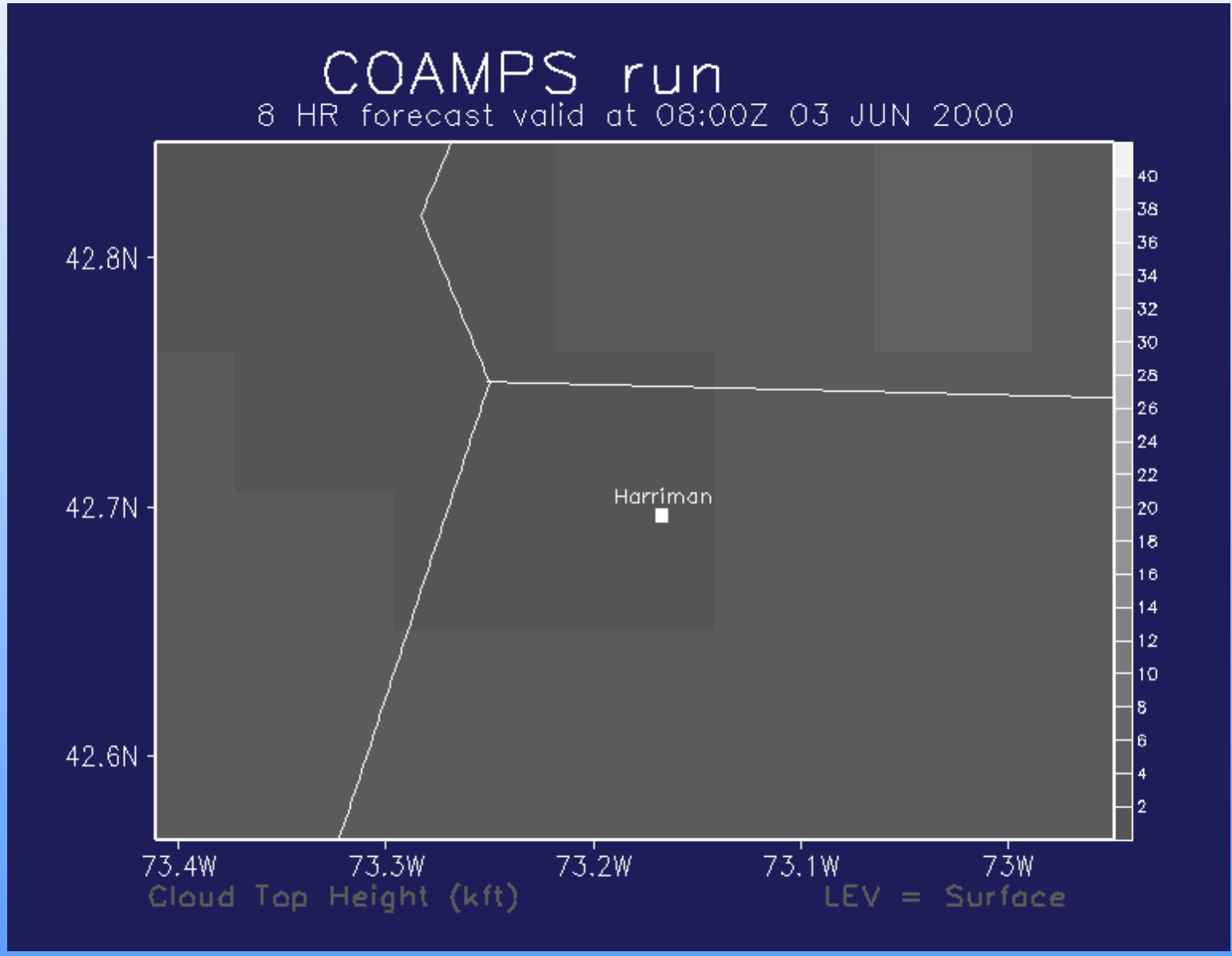
Heat Index Forecast



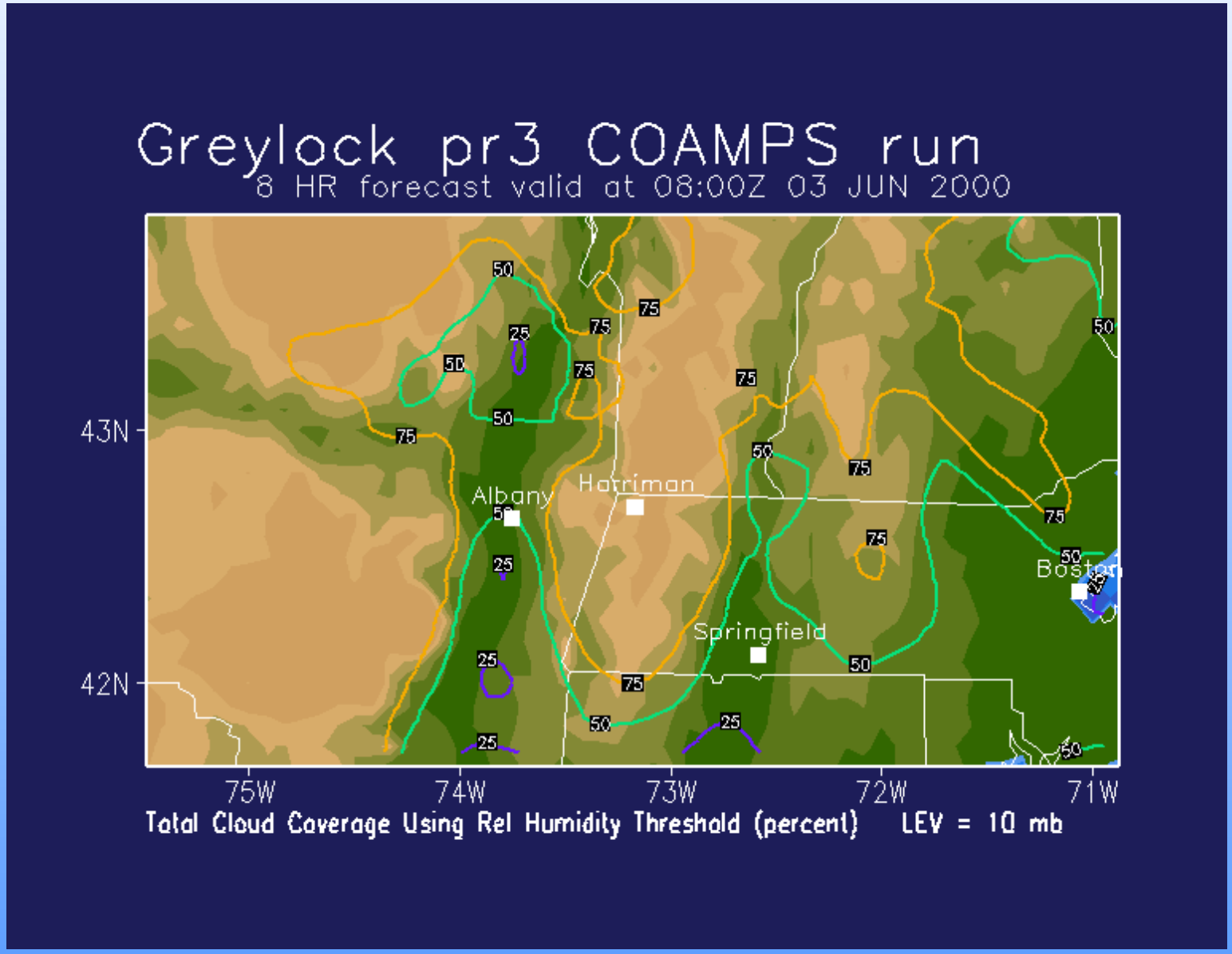
Cloud Ceiling Height Forecast



Cloud Top Height Forecast



Percent Cloud Coverage Forecast



Meteograms

Time-Height Series at a Single Location

Wind Barbs (kts)
Temperature (F)
RH > 70%
Freezing level

Altimeter Setting (in Hg)

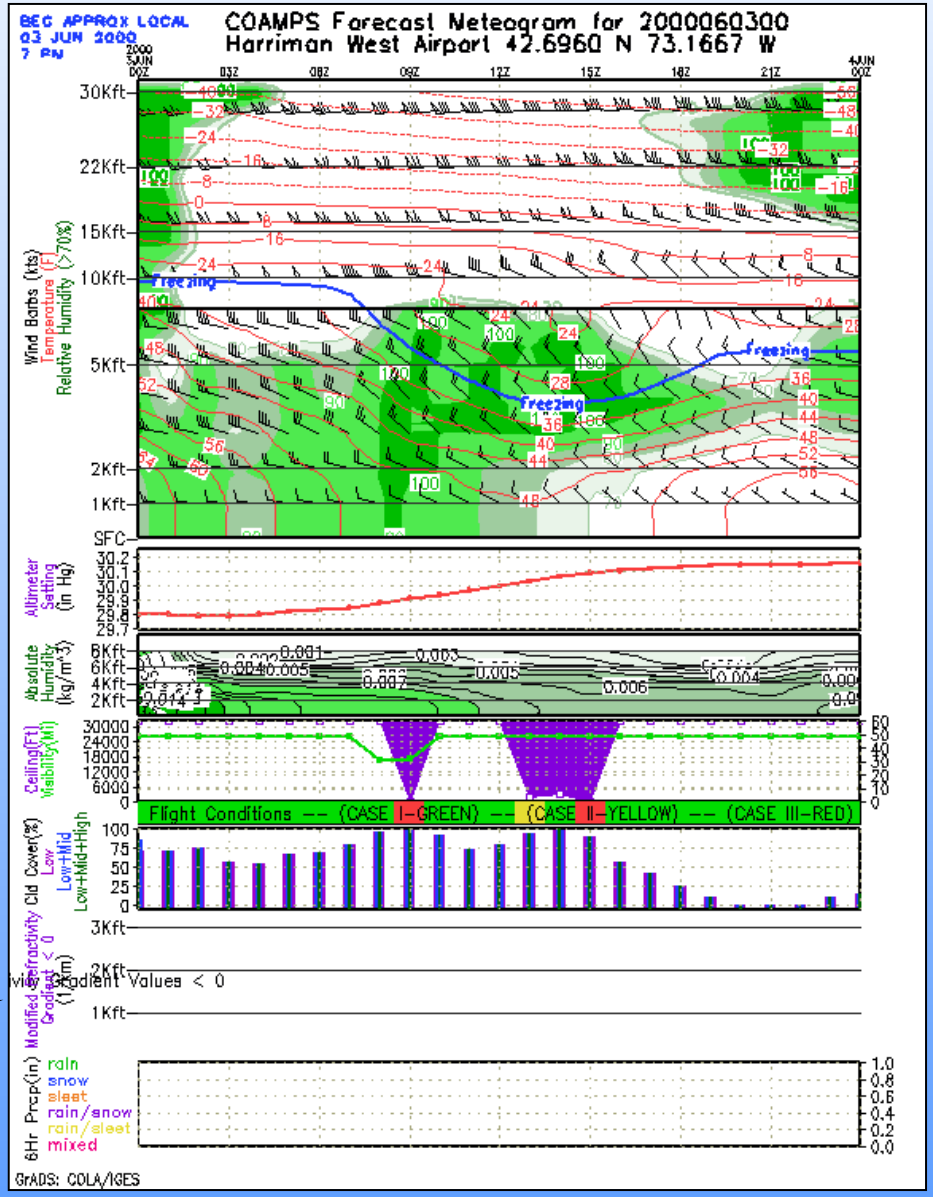
Absolute Humidity (kg/m3)**

Ceiling Height (ft)
Visibility (mi)
Flight Category

Cloud Coverage (%)

Trapping Layer Altitudes (ft)

Precipitation (in)



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Nowcast 6.2 Review

Data Assimilation

1:00 - 1:15 COAMPS-OS/SPAWAR Horizontal Integration — John Cook (NRL)

1:15 - 1:30 ADAS/3D-VAR — Allen Zhao (NRL)

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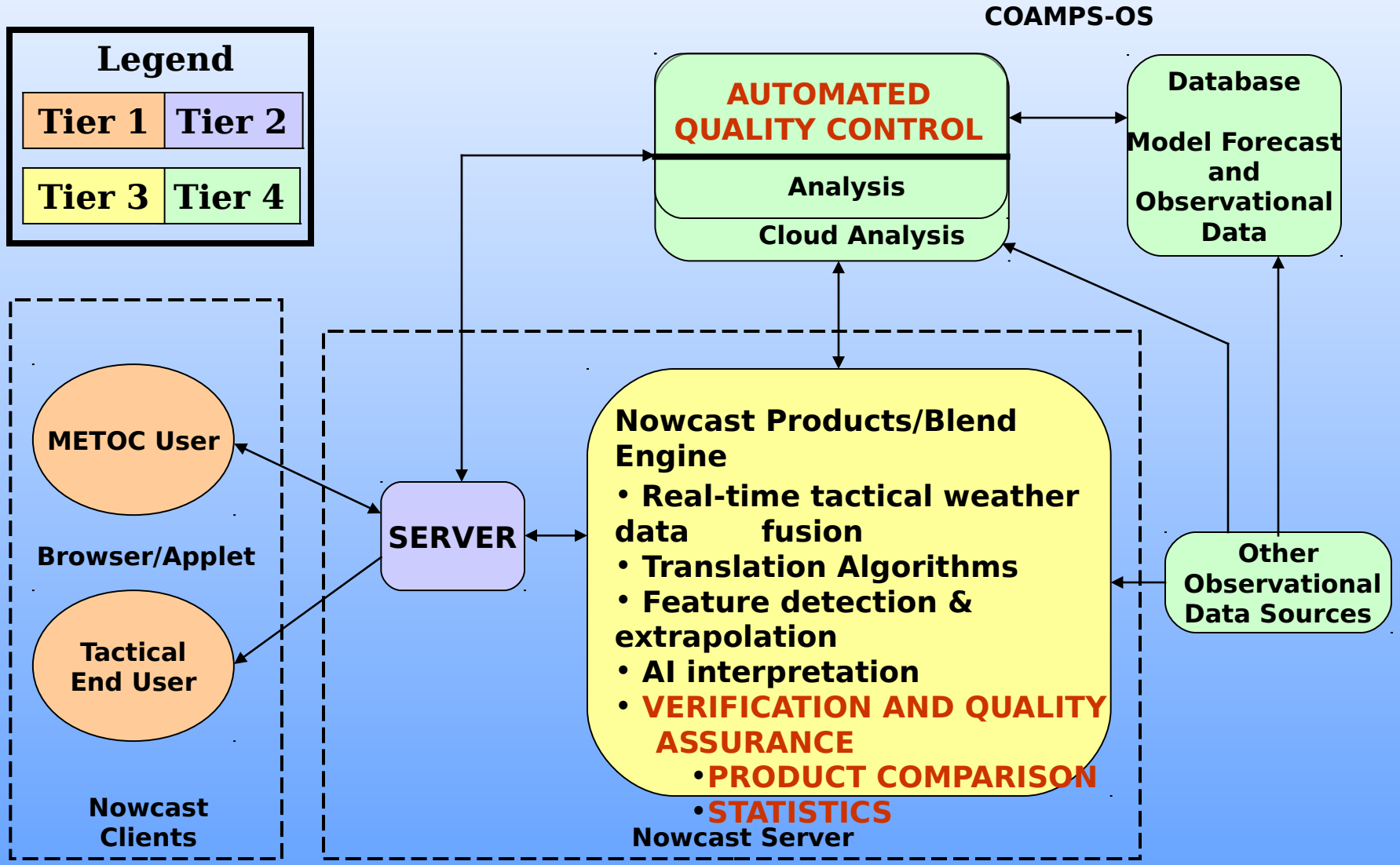
Verification and Validation for NOWCAST

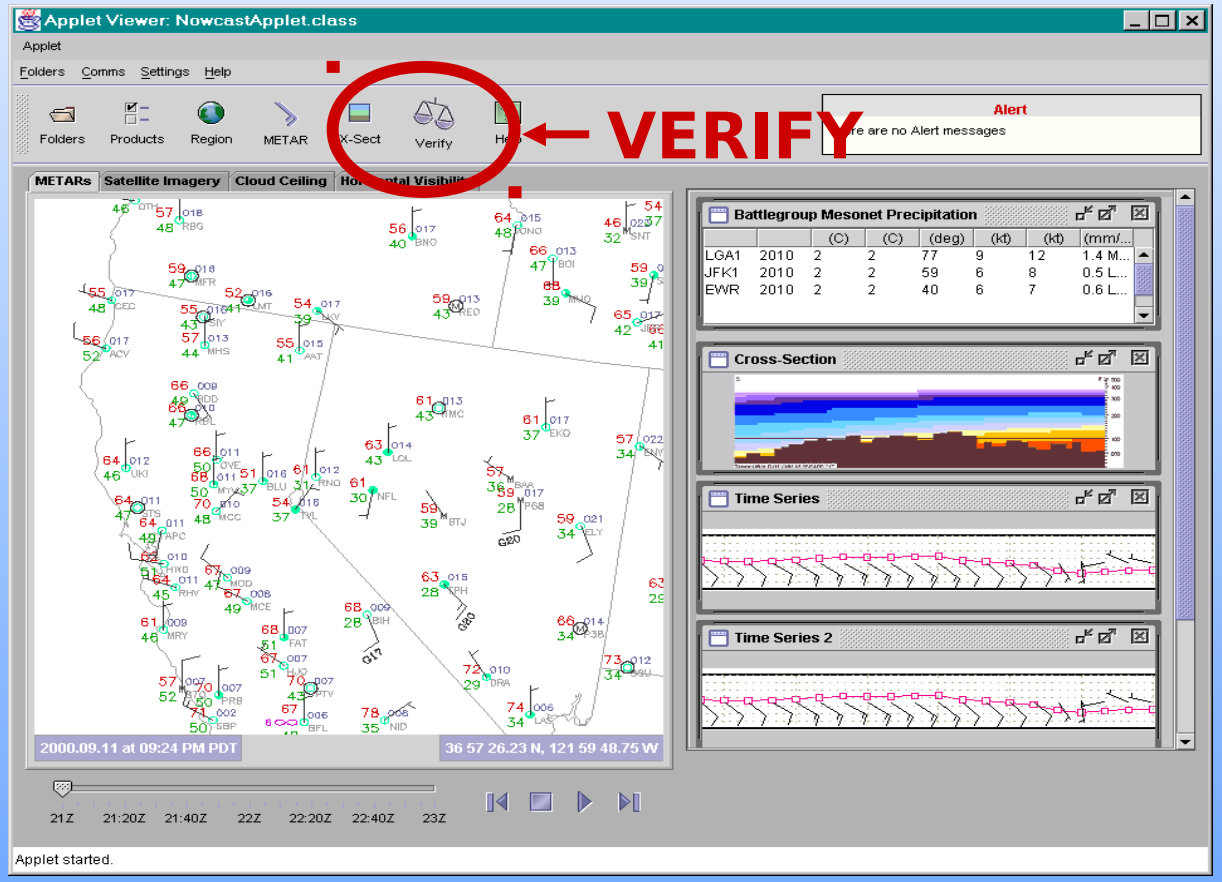
Rosemary Lande
Gary Love

12 September 2000

Nowcast Design



Nowcast GUI



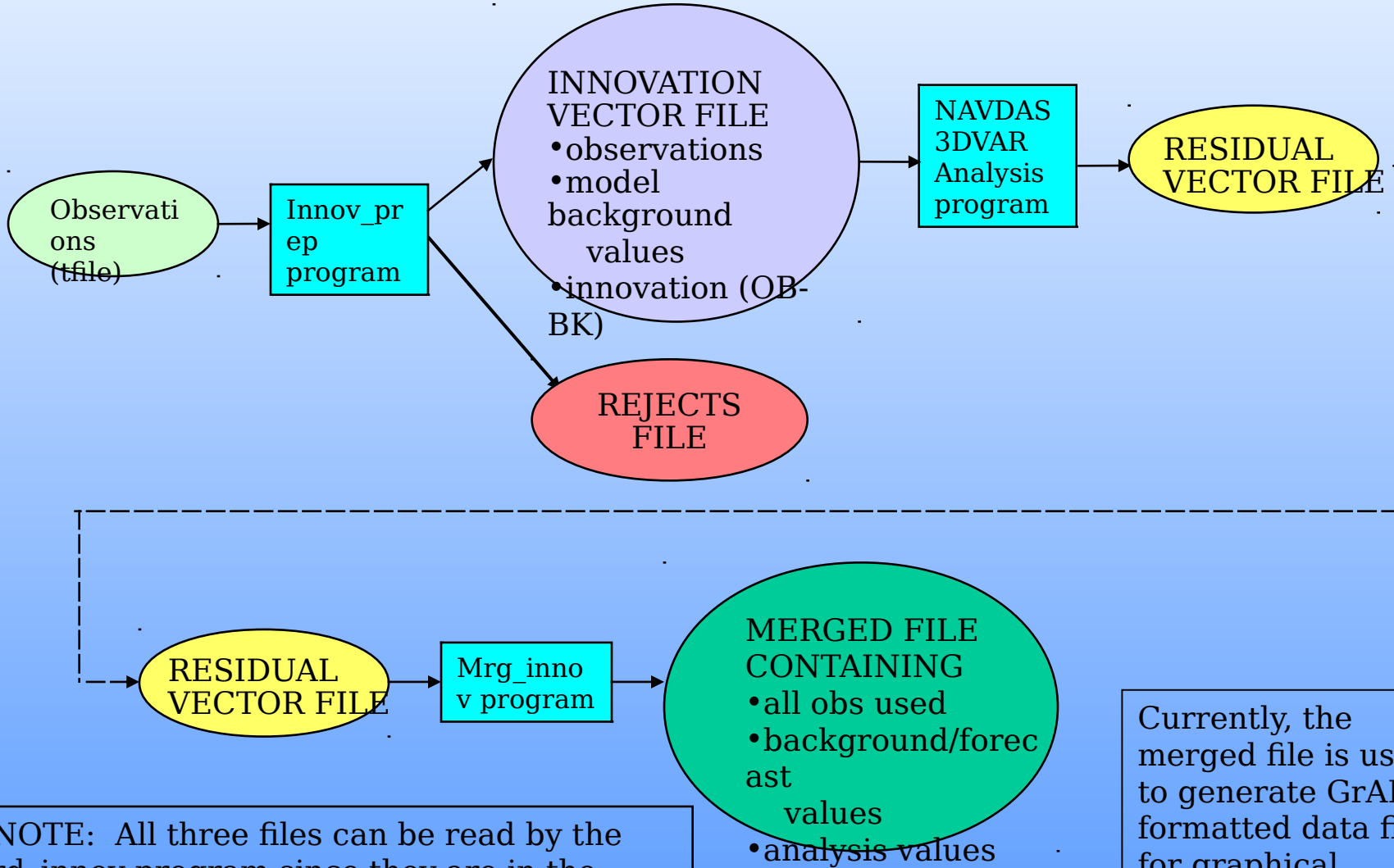
ULTIMATE GOAL:

Each Nowcast product will have a verificati product and/or "confidence leve associated with it.

Products

- **Time Series with Statistics and Threshold Alerts**
- **METQC Data Monitoring and Visualization**
- **Probability of Detection from Contingency Tables**
- **Comparisons with Satellite Imagery and Radar**
- **Quantitative Precipitation Forecast (QPF) Verification**
- **Scoring Verification (New Zealand Skill Scores)**

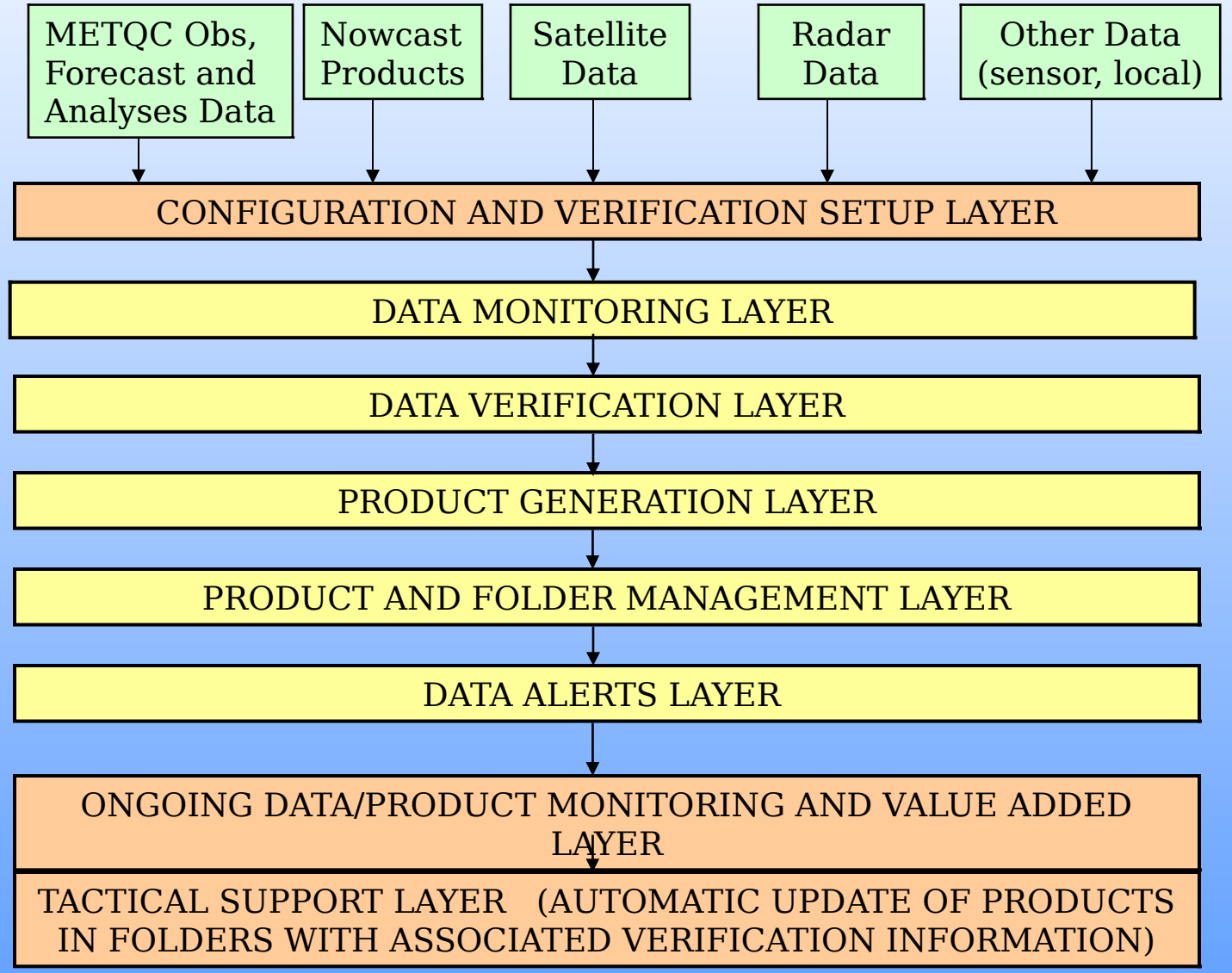
METQC Generation of Data Files



NOTE: All three files can be read by the rd_innov program since they are in the same format.

Currently, the merged file is used to generate GrADS formatted data files for graphical displays.

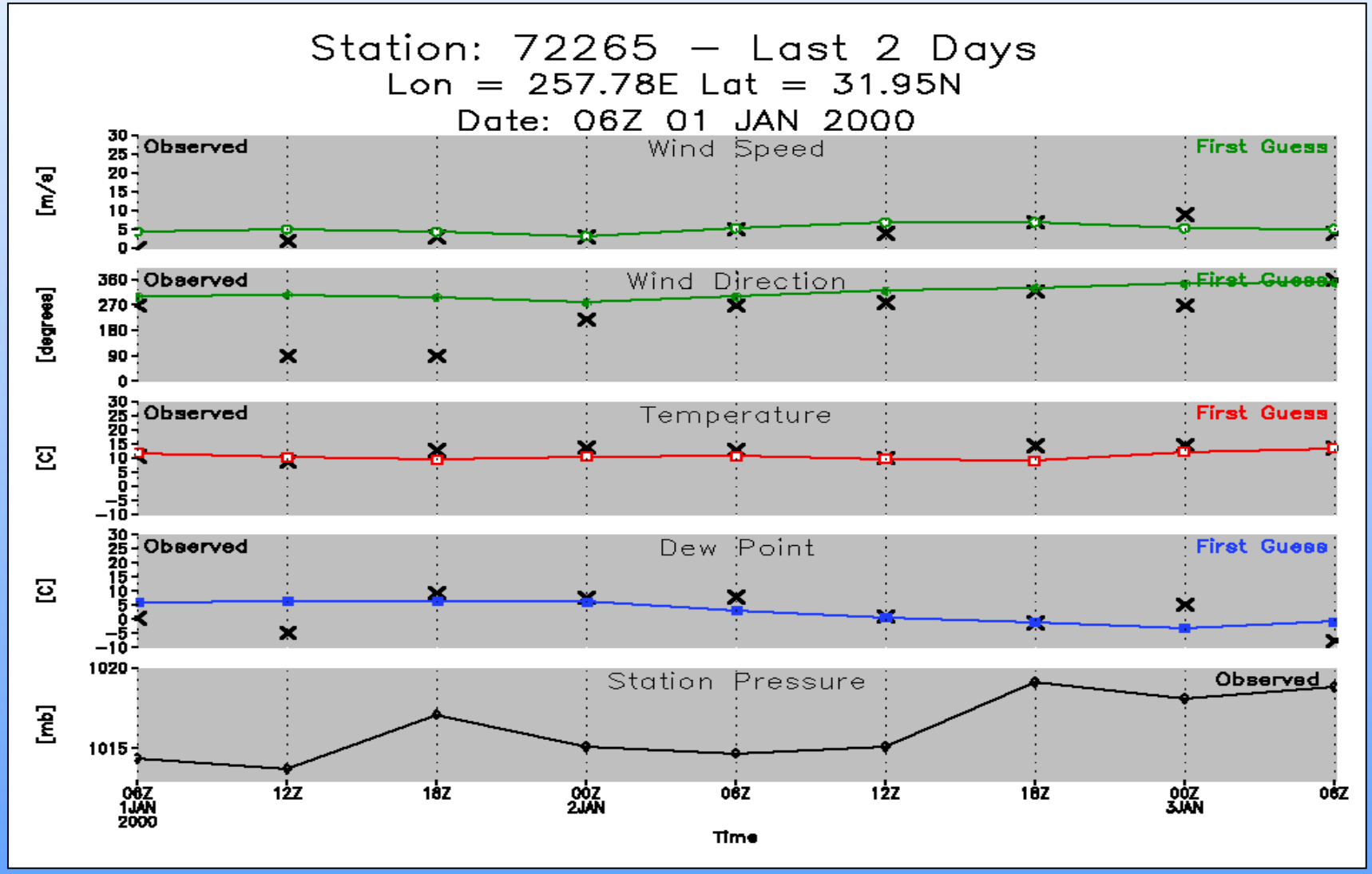
Layered Approach to Quality Assurance and Verification



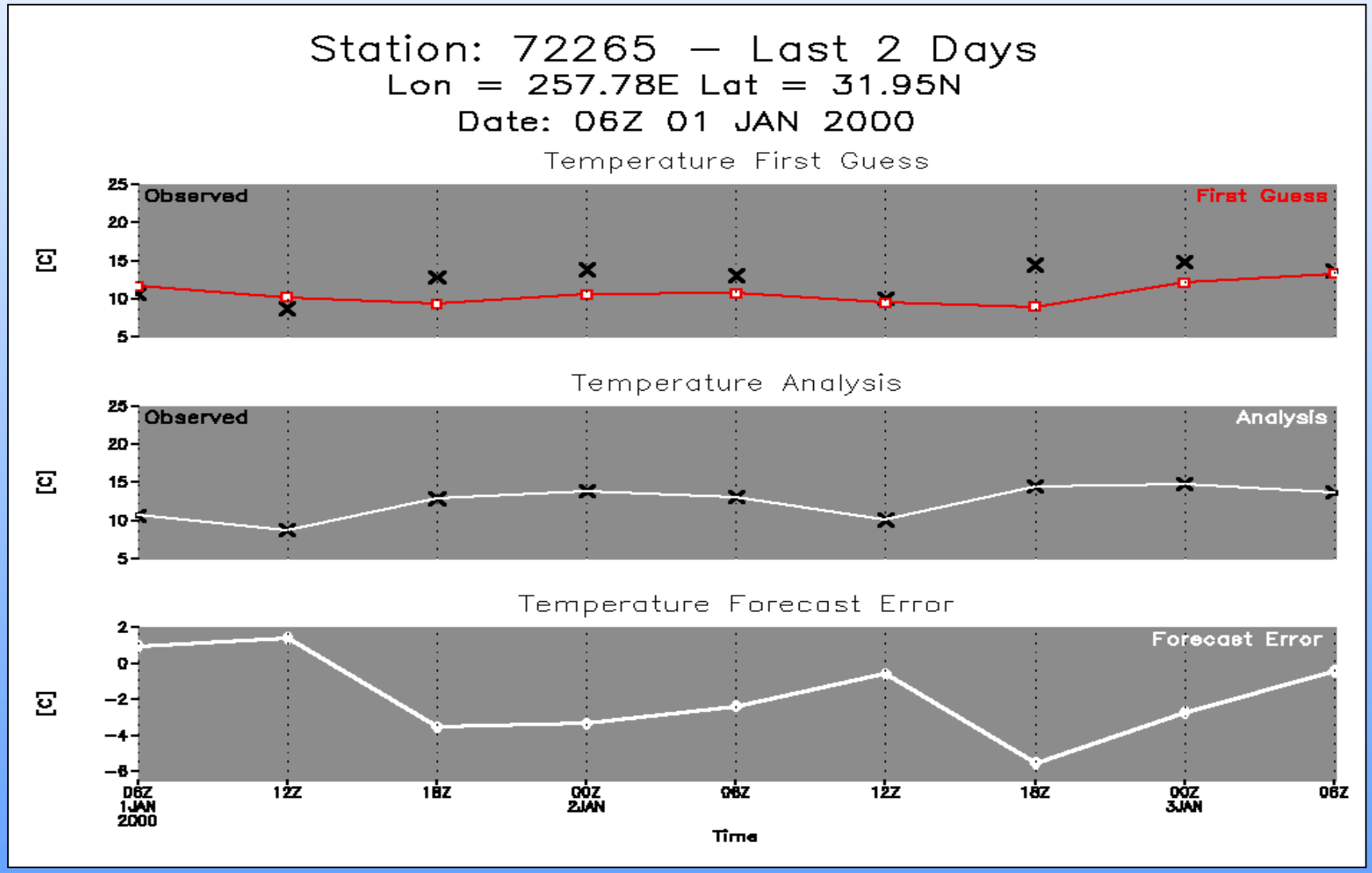
Time Series with Statistics and Threshold Alerts

- Time series for single station
- Multiple parameters
  - wind speed
  - wind direction
  - temperature
  - dew point
  - station pressure
- Statistics (rms, std, bias)
- Alert conditions (thresholds)

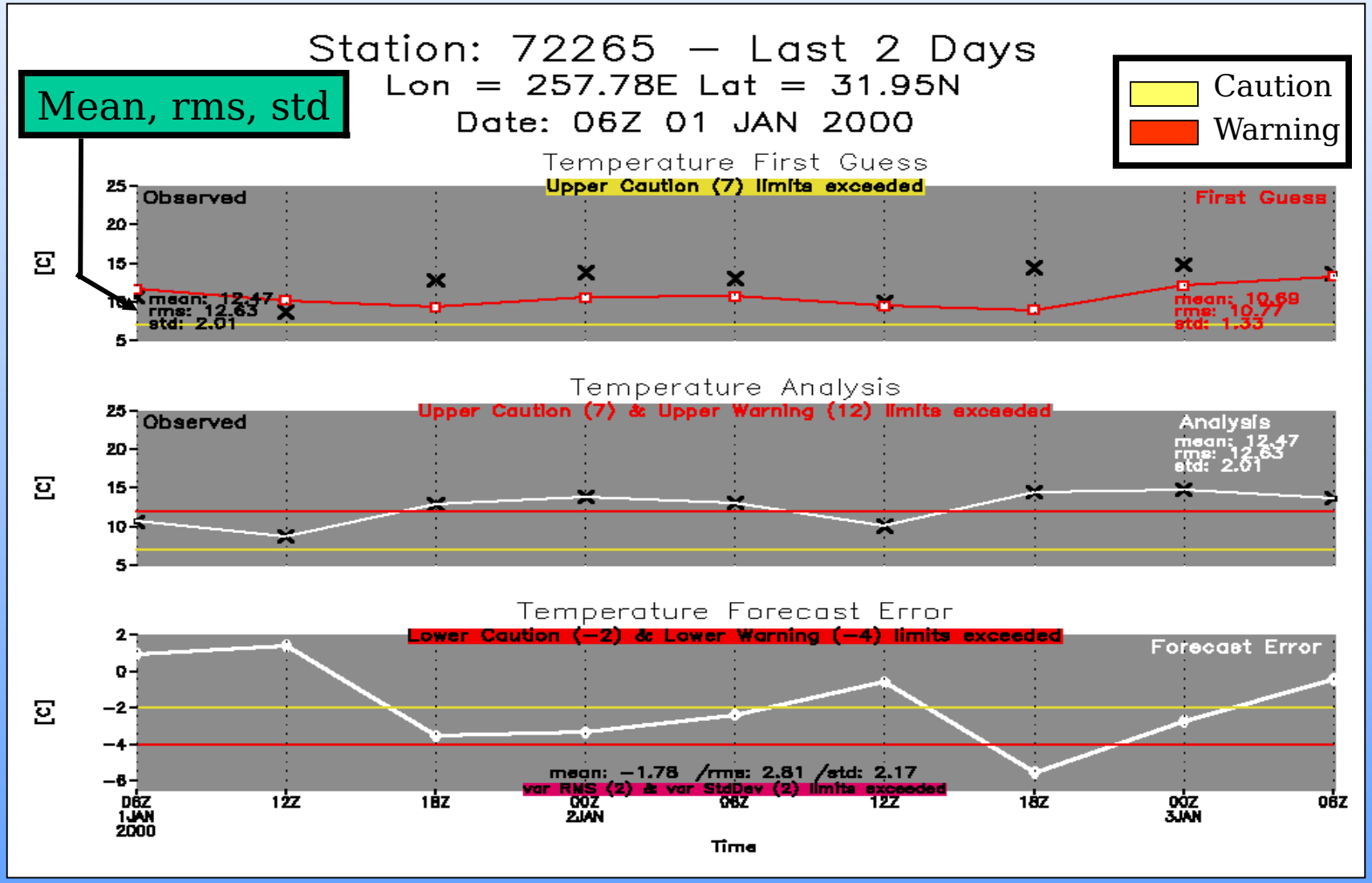
Time Series for Multiple Parameters



Time Series Comparison for a Single Parameter



Statistics and Threshold Alerts

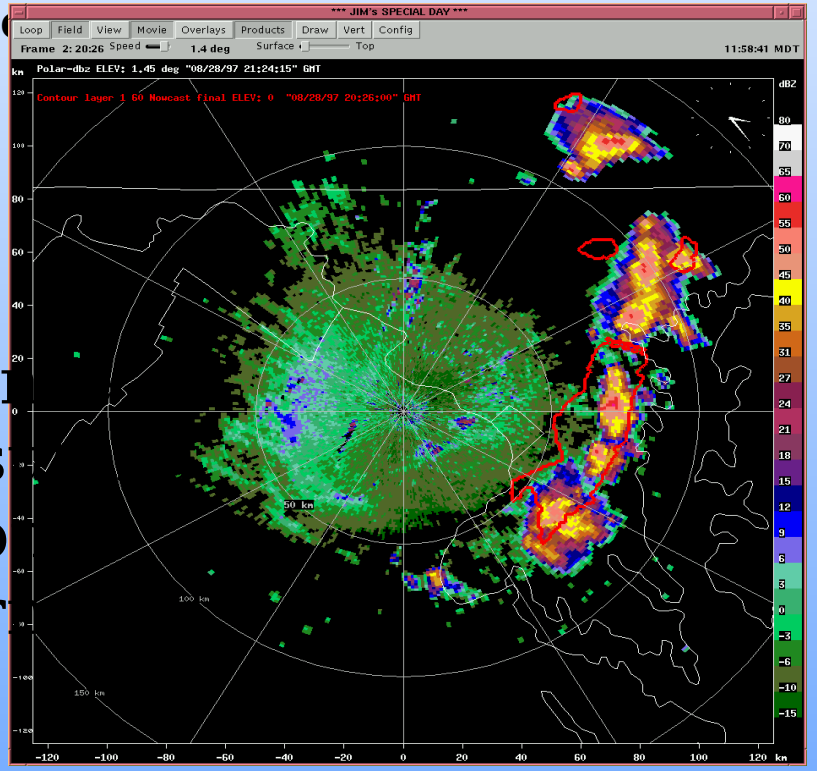


Contingency Table Analyses of NCAR Autonowcaster Radar Product

- **Boundary detection and characterization**
- **Extrapolation to forecast thunderstorm movement, initiation, and decay**
- **60 min forecast and verificati**

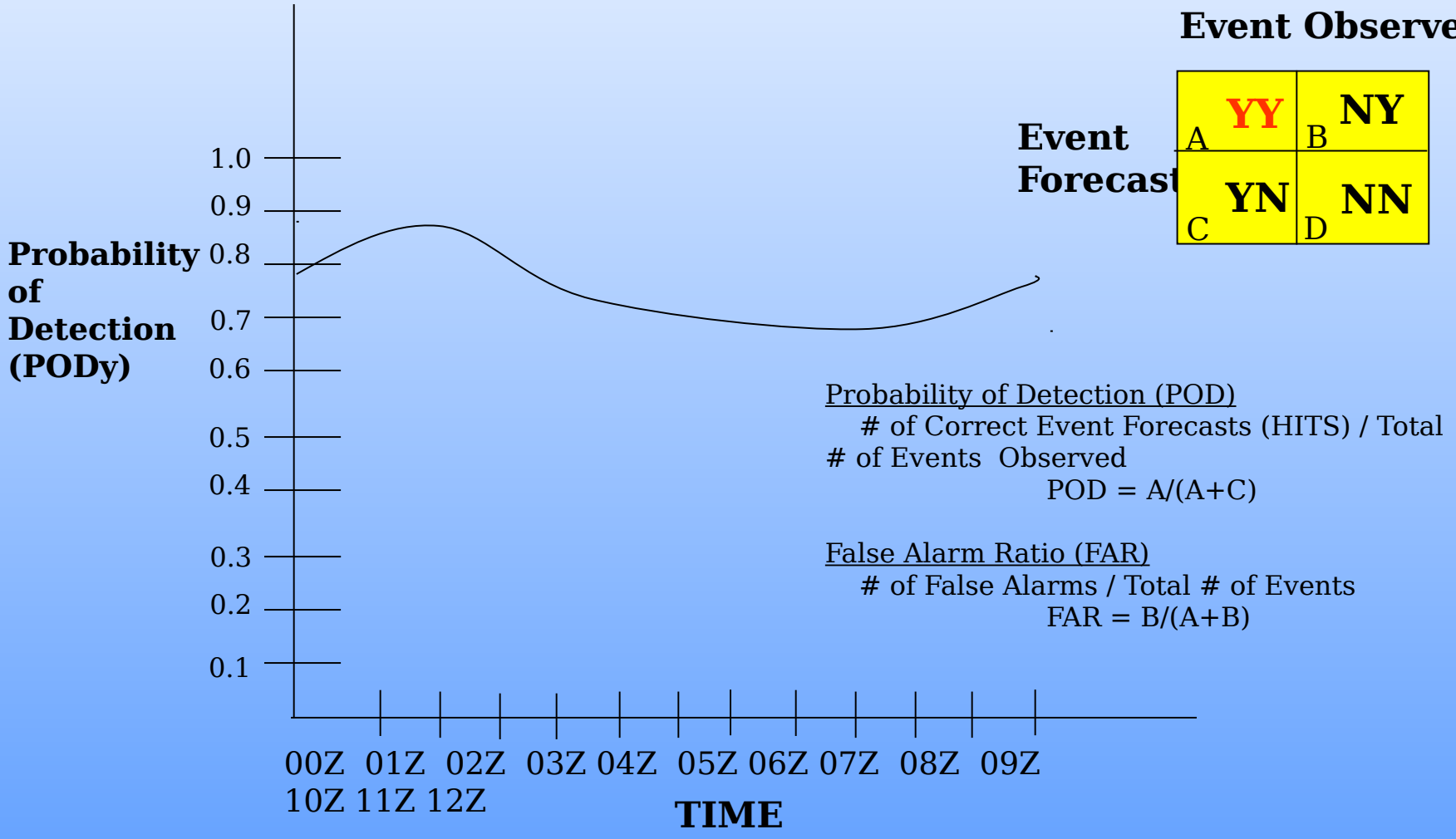
VERIFICATION:

- Running graph of confide
- Pixel by pixel analysis res
  in Probability of Detectio
  (PODy) and/or False Alar
  Rate (FAR)



Jim Wilson, NCAR

Probability of Detection Using Contingency Tables



Probability of Detection (POD)
# of Correct Event Forecasts (HITS) / Total # of Events Observed
POD = A/(A+C)

False Alarm Ratio (FAR)
# of False Alarms / Total # of Events
FAR = B/(A+B)

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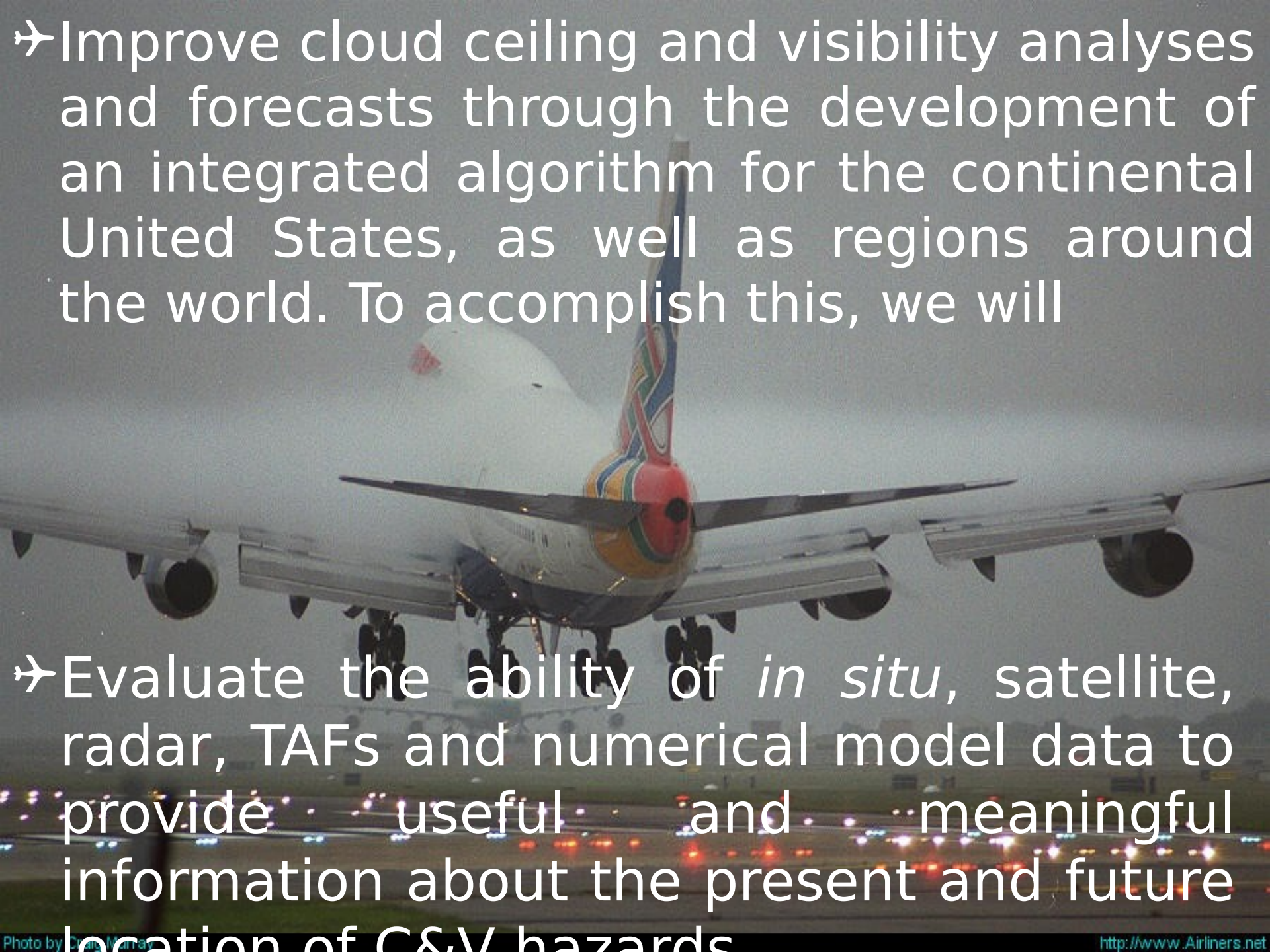
A FUZZY LOGIC SYSTEM FOR THE ANALYSIS AND PREDICTION OF CLOUD CEILING AND VISIBILITY

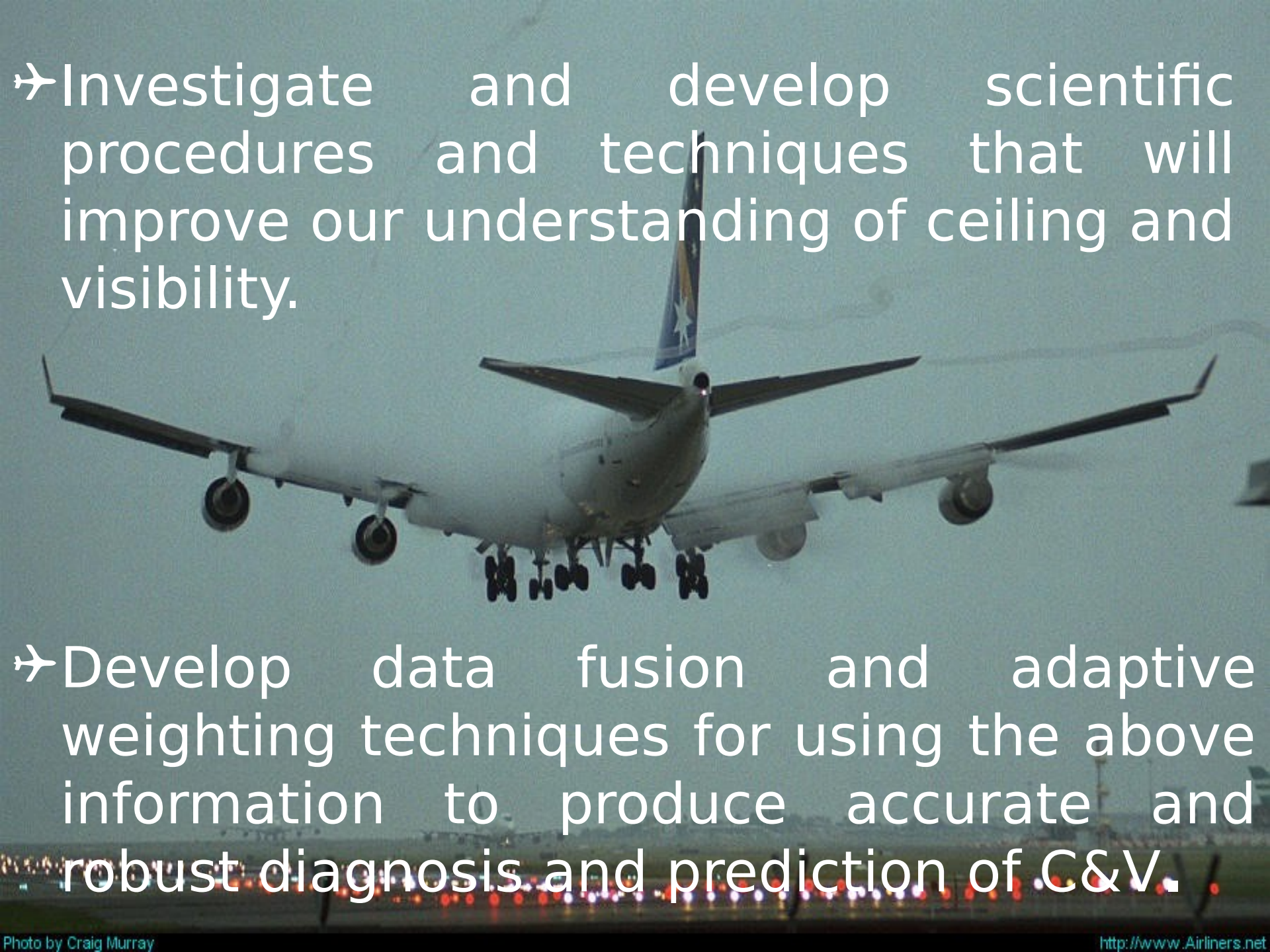
FAA
NASA
NAVY

Kevin Petty
Bruce Carmichael
Gerry Wiener
Martha Limber
Melissa Petty



- Improve cloud ceiling and visibility analyses and forecasts through the development of an integrated algorithm for the continental United States, as well as regions around the world. To accomplish this, we will

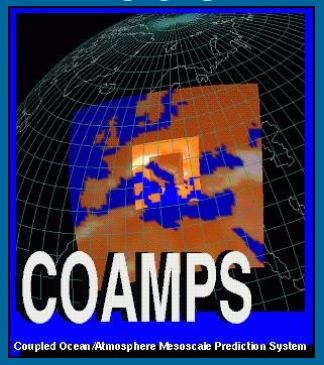
- Evaluate the ability of *in situ*, satellite, radar, TAFs and numerical model data to provide useful and meaningful information about the present and future location of C&V hazards



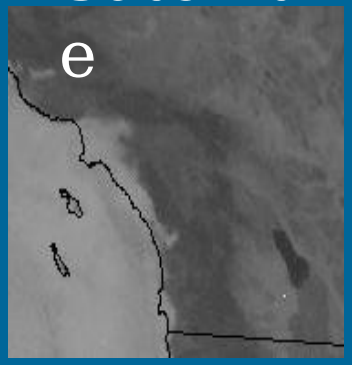
- Investigate and develop scientific procedures and techniques that will improve our understanding of ceiling and visibility.
- Develop data fusion and adaptive weighting techniques for using the above information to produce accurate and robust diagnosis and prediction of C&V.

DATA SOURCES

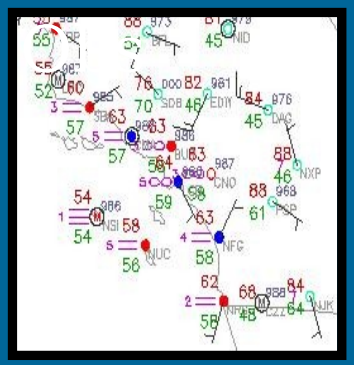
Model



Satellite

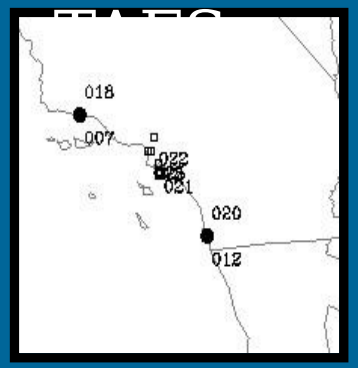


Surface



Radar

PIREPS/ TAFS



COAMPS RUC II

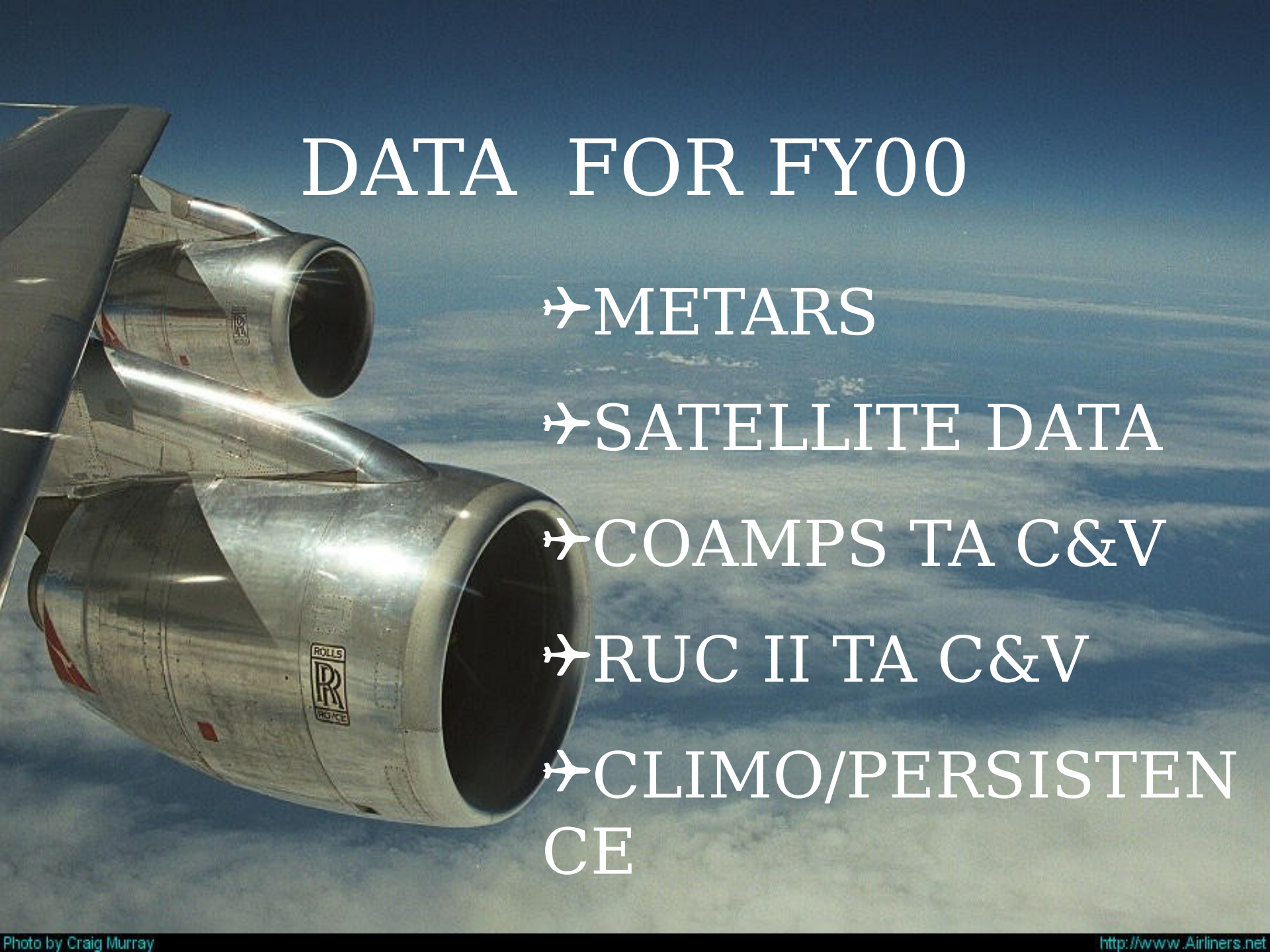
Cloud classification/ Low cloud

METARS/ CLIMO

NEXRAD / Radar Mosaic

Assign functions and dynamic weights/Automatic verification

Final C&V product



DATA FOR FY00

- METARS
- SATELLITE DATA
- COAMPS TA C&V
- RUC II TA C&V
- CLIMO/PERSISTENCE

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CEILING AND VISIBILITY

INTERPOLATED METARS OVER CONUS

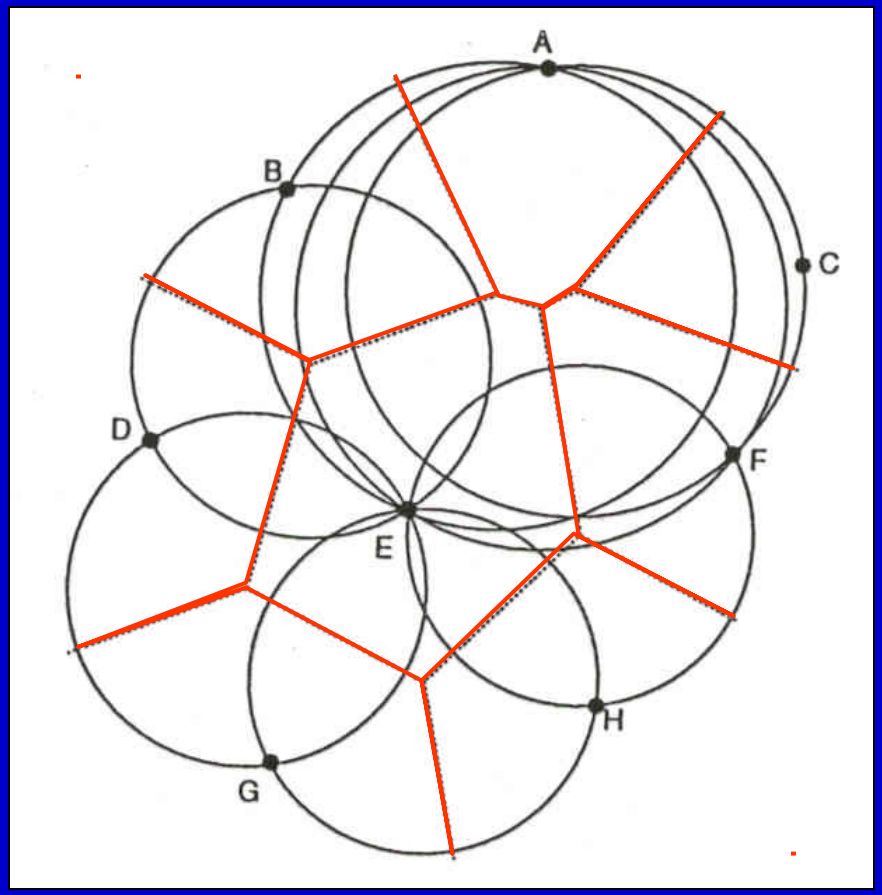
Explored different interpolation schemes

- Barnes
- Nearest Neighbor
- Natural Neighbor

National Center for Atmospheric Research

CEILING AND VISIBILITY

VORONOI POLYGONS AND NATURAL NEIGHBOR CIRC

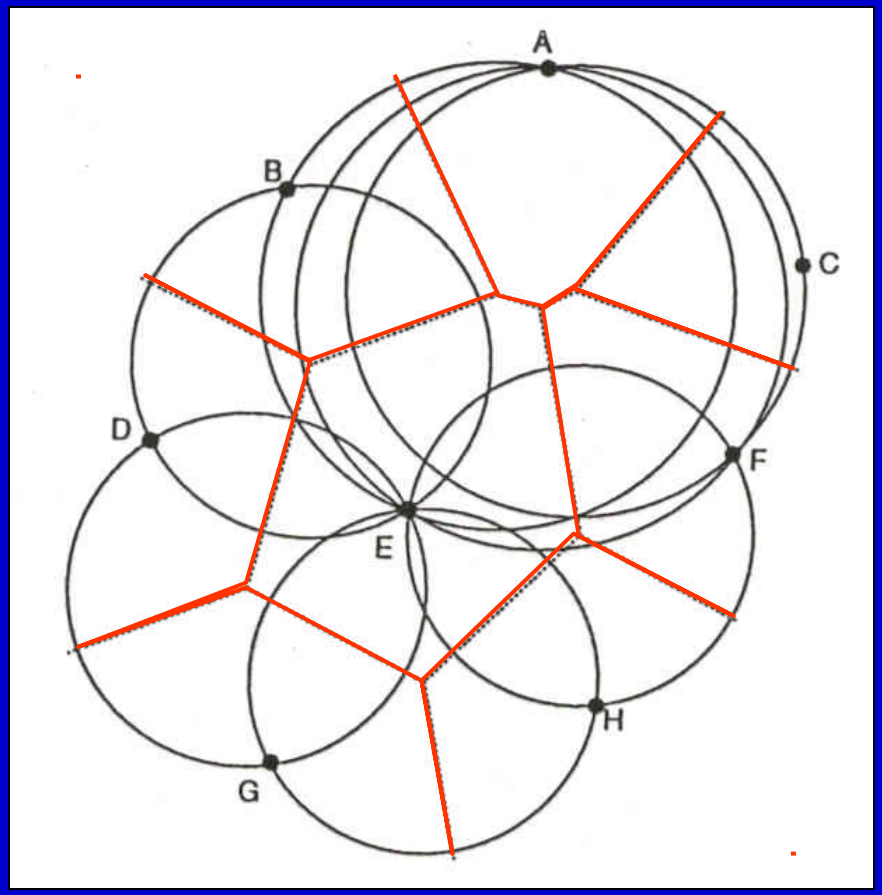


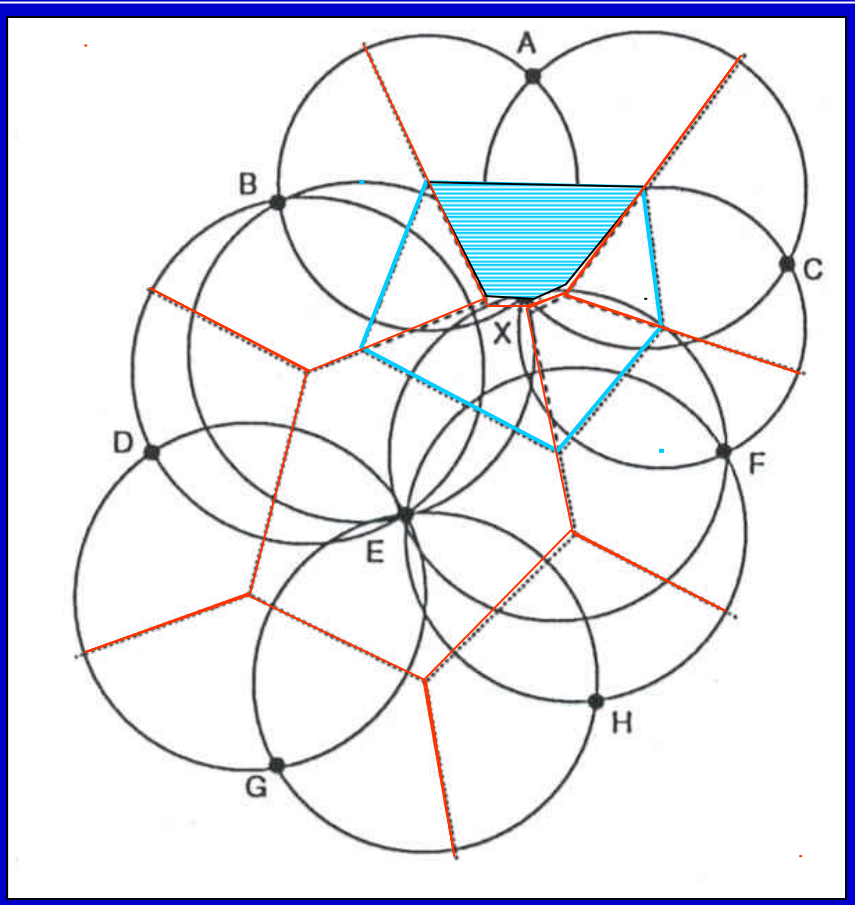
- Weighted average method
- Benefit of the technique:
  - · Way points are selected-avoids selecting a fixed number of points or choosing some arbitrary distance
  - · How weights are determined-by proportionate areas

National Center for Atmospheric Research

CEILING AND VISIBILITY

VORONOI POLYGONS AND NATURAL NEIGHBOR CIRC





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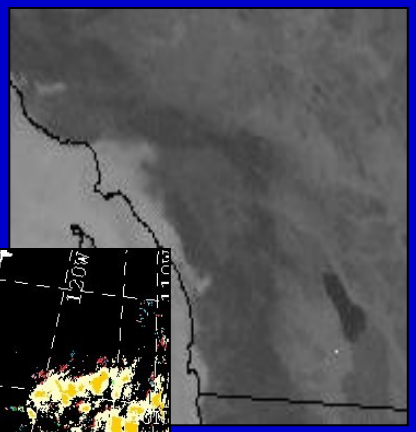
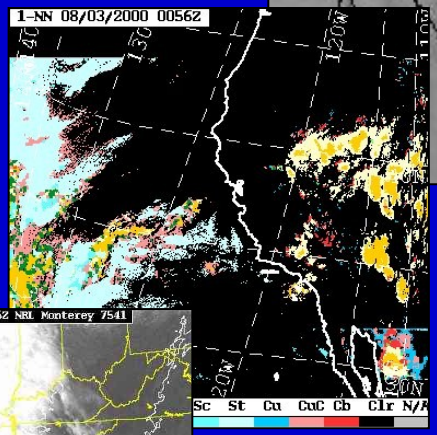
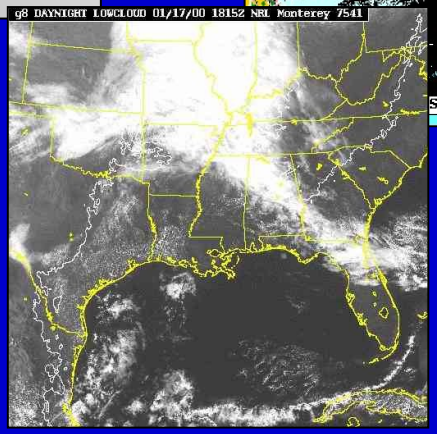
CEILING AND VISIBILITY

SATELLITE DATA

- Cloud Mask
- Low Cloud
- Cloud Classification







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CEILING AND VISIBILITY

RUC II AND COAMPS DERIVED CEILING AND VISIBILITY FIELDS

TRANSLATION ALGORITHM (Stoelinga and Warner, 1999) based on empirical and theoretical relationships between hydrometeor attributes and light extinction is used to produce Ceiling and Visibility fields from numerical models.

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CEILING AND VISIBILITY

$$\chi_{vis} = \frac{-\ln(0.02)}{\beta}$$

$$\beta = \beta_{ci} + \beta_{cw} + \beta_{sn} + \beta_{rn}$$

=Mass Concentration (gm^{-3})

β = Extinction coefficient

$$\beta_{ci} = 163.9\,C^{1.00}$$

$$\beta_{cw} = 144.7\,C^{0.88}$$

$$\beta_{sn} = 10.4\,C^{0.78}$$

$$\beta_{rn} = 1.1\,C^{0.75}$$

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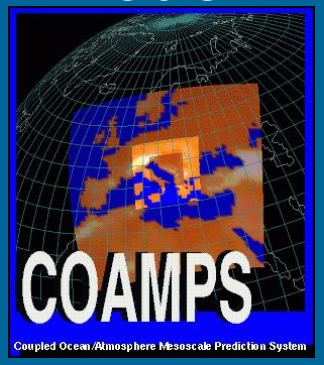
CEILING AND VISIBILITY

✳CLIMATOLOGY AND PERSISTENCE

- climatology dataset
- Exploring methods related to forecasting C&V using climatology.

DATA SOURCES

Model



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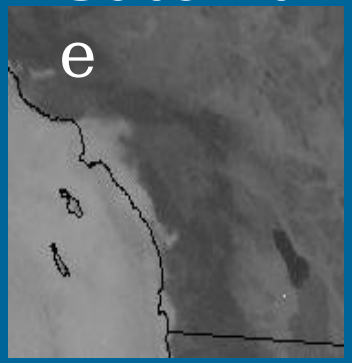
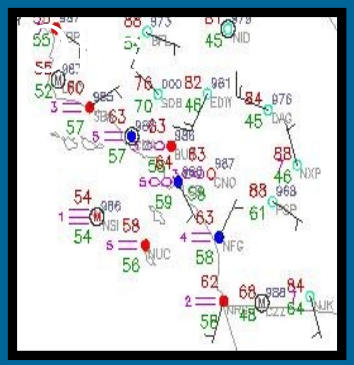


Surface



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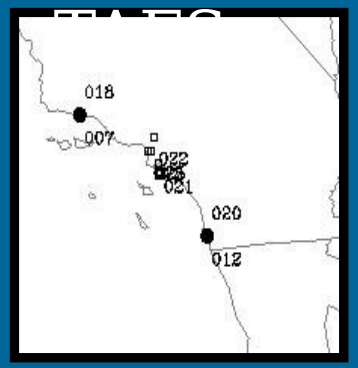

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National Center for Atmospheric Research

CEILING AND VISIBILITY

$$Xf = \frac{\left[\sum_{i=1}^{n_f} w_{if} c_{xif} X_{if}\right]}{\left[\sum_{i=1}^{n_f} w_{if} c_{xif}\right]} + b_f$$

Standard additive Model (SA
Kosko, 1997

- X_f, where f is ceiling or visibility, is the weighted normalized sum of the member inputs.
- w denotes the weight applied to the inputs
- c is the confidence value. A confidence of zero would indicate that the input is not available and would be excluded from the sum.
- b is the bias produced by the system .

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CEILING AND VISIBILITY

Algorithm Strengths

- Its ability to easily accommodate new inputs
- The capacity to produce analyses and prediction when individual inputs are missing
- The ability to dynamically adjust according to h each input verifies.

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CEILING AND VISIBILITY

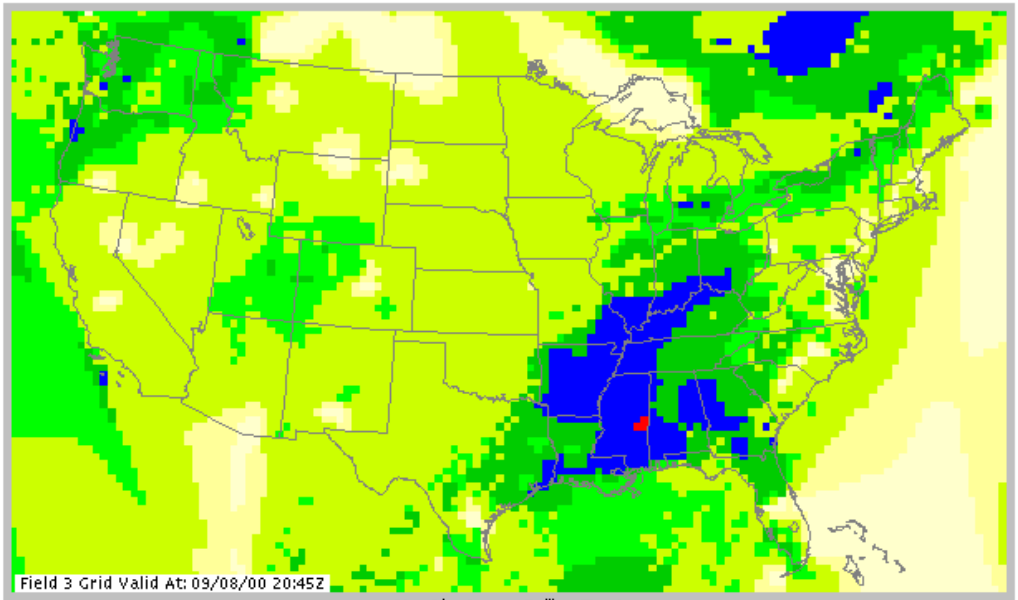
- Basic framework is in place.
  - Modular (adding and subtracting components)
  - Benefit the verification process (Did it help?)
  - Easier to trace problems (Where's the problem?)
  - Focus on the Science

File Edit View Go Communicator Help

Back Forward Reload Home Search Netscape Print Security Stop

Bookmarks Location: http://www.rap.ucar.edu/~paddy/cvis2/ What's Related

WebMail People Yellow Pages Download New & Cool Channels



Map:
Configure...
Overview...
Reset
Un-zoom
Reload

Field:
- Topography
- Visibility
- Ceiling
- MSL Pressure
- Temperature
- Dewpoint
- Wind Speed
- Flight Category

Overlays:
- Wind Barbs
- VORs
- TAFs
- METARs

METAR Options:
- Wind
- Temperature
- Altimeter
- Dewpoint
- Ceiling
- Visibility
- Weather
- Station ID
- All

Show METARs:
- All
- More
- Default
- Fewer

100%

Field 8 Grid Valid At:

LIFR

VFR

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CEILING AND VISIBILITY

✳ *FUTURE AREAS OF FOCUS*

✳Further Development of TA.

- ·Aerosols
- ·Blowing dust & snow

✳Scientific Techniques

- ·Satellite techniques
- ·Statistical methods

✳Other data sources

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Tactical Environmental Processor NRL Briefing
12 September 2000

Cathy Kessinger
NCAR

Tactical Environmental Processor

- Goal
  - Evaluate feasibility of using land-based radar algorithms for oceanic environment
    - Thunderstorm forecasts - time and space specific
      - Detection of boundary layer convergence zones
    - Microbursts - aviation hazards
    - Data quality

The O'Kane Data Set

- Received Universal Format (UF) files from Lockheed-Martin (LM) in August
- Data set includes:
  - 8 cases from East Coast transit
  - 2 cases from Panama Canal transit
  - 3 cases from Hawaii
  - Jacksonville, FL case most complete
    - 21 volumes over 3 hour period
- Weather types:
  - Clear air
  - Precipitation

The O'Kane Data Set

- Corrections made to the UF files
  - Sweep numbers added
  - Scan mode changed (from MAN to SUR)
  - Nominal PRF inserted
  - Range to the first gate corrected
  - Time stamps made to increment positively

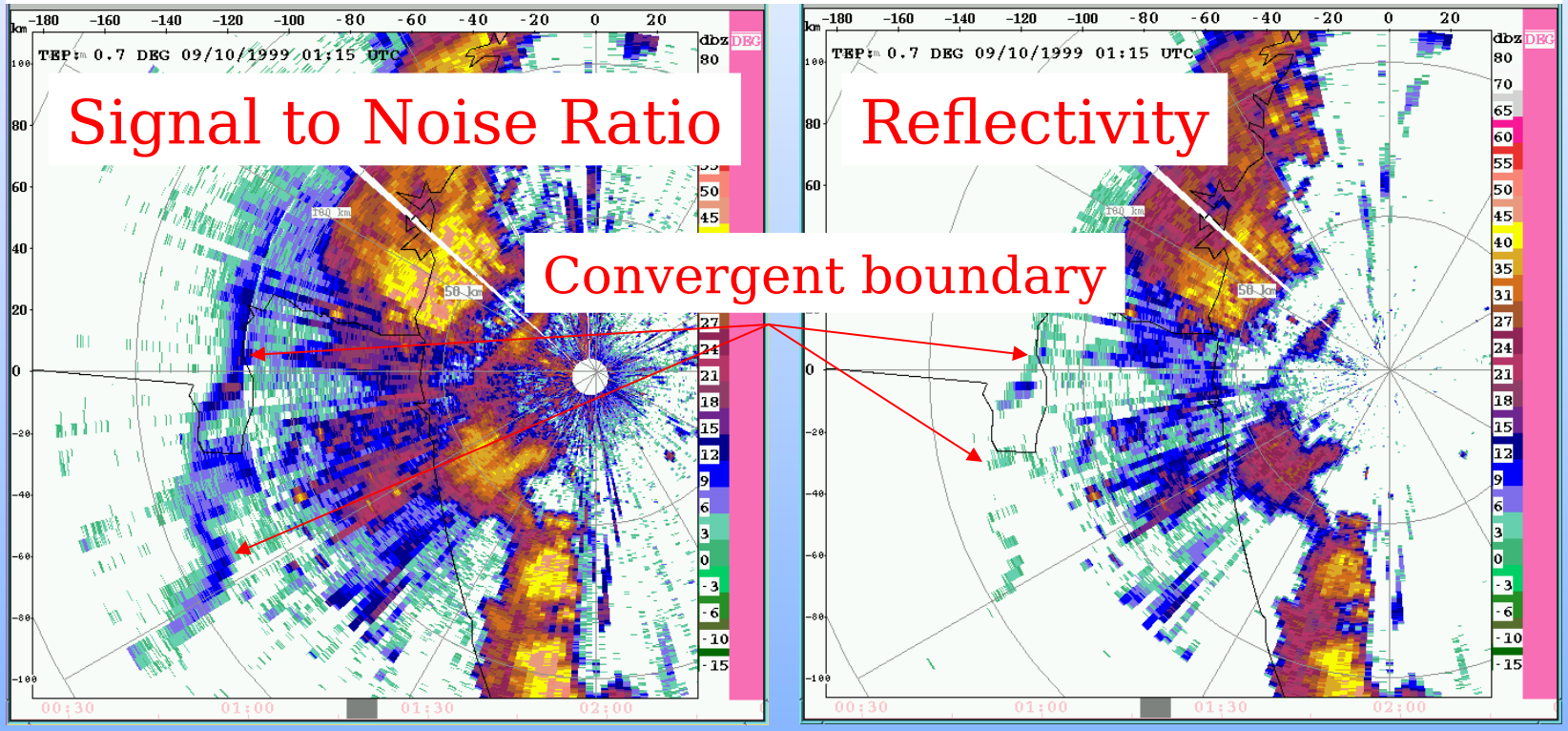
Radar Data

- Converted UF data to NCAR Cartesian and polar coordinate files
- Changing software to account for moving platform
- Quickly perused most of data
- Ran storm tracking algorithm (TITAN) on Jacksonville case

Clear Air Cases

- Important to know how much, if any, clear air return can be seen by TEP over ocean
  - Not much expected due to lack of insects
  - Convergence boundaries indicate potential for convective initiation/redevelopment
  - Wind flow important for aviation operations
- Amount of radar return can be dependent on radar scanning strategy

Detection of Boundaries



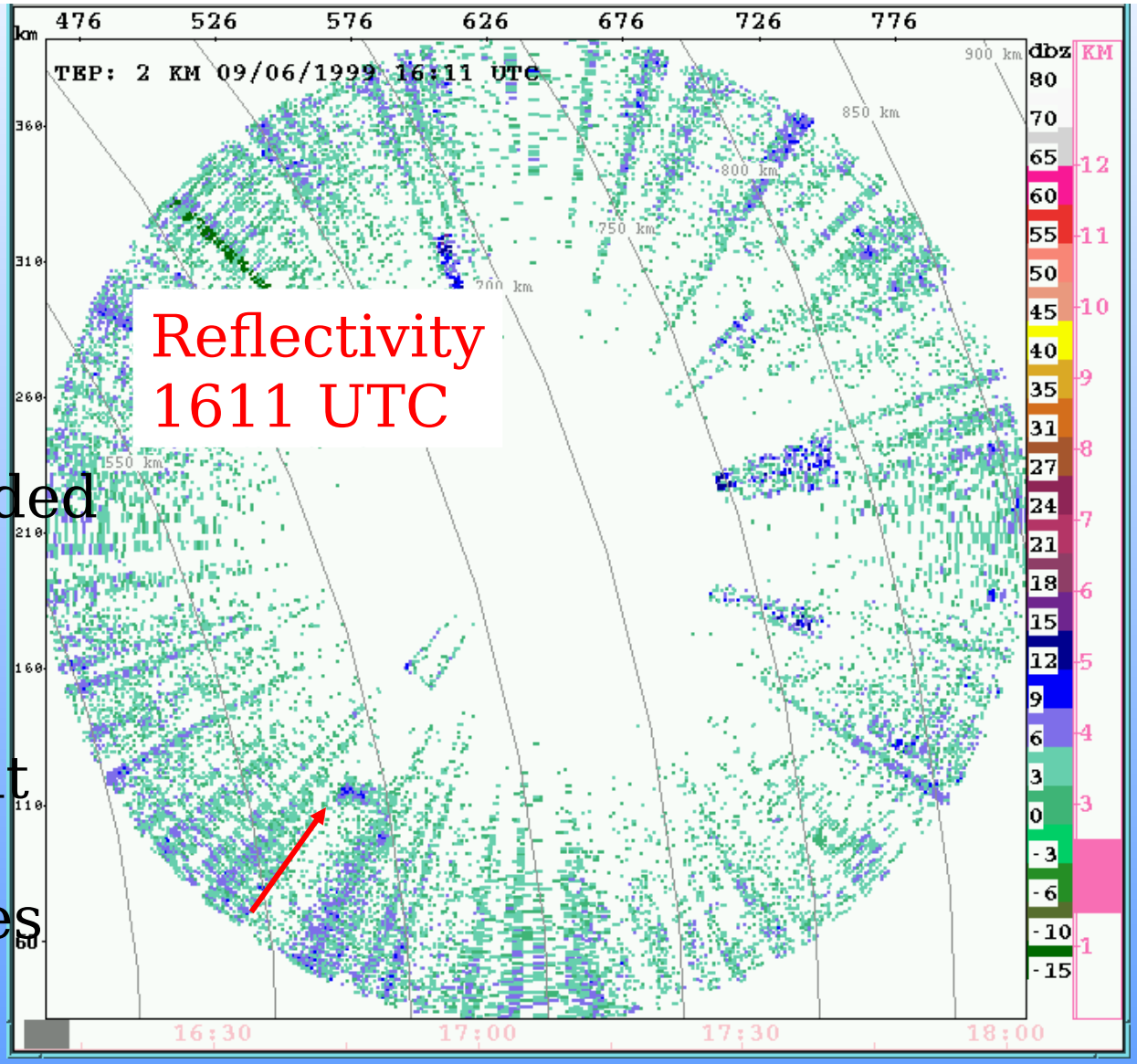
Boundary can be seen better in SNR field due to dBZ t
Boundary is over land and not ocean
TEP can detect boundaries over land

Clouds

TEP easily sees clouds that are developing

Comparison to satellite data needed

G. Young notes “scattered trade cumulus to distant starboard”. Ship course: 90 degrees



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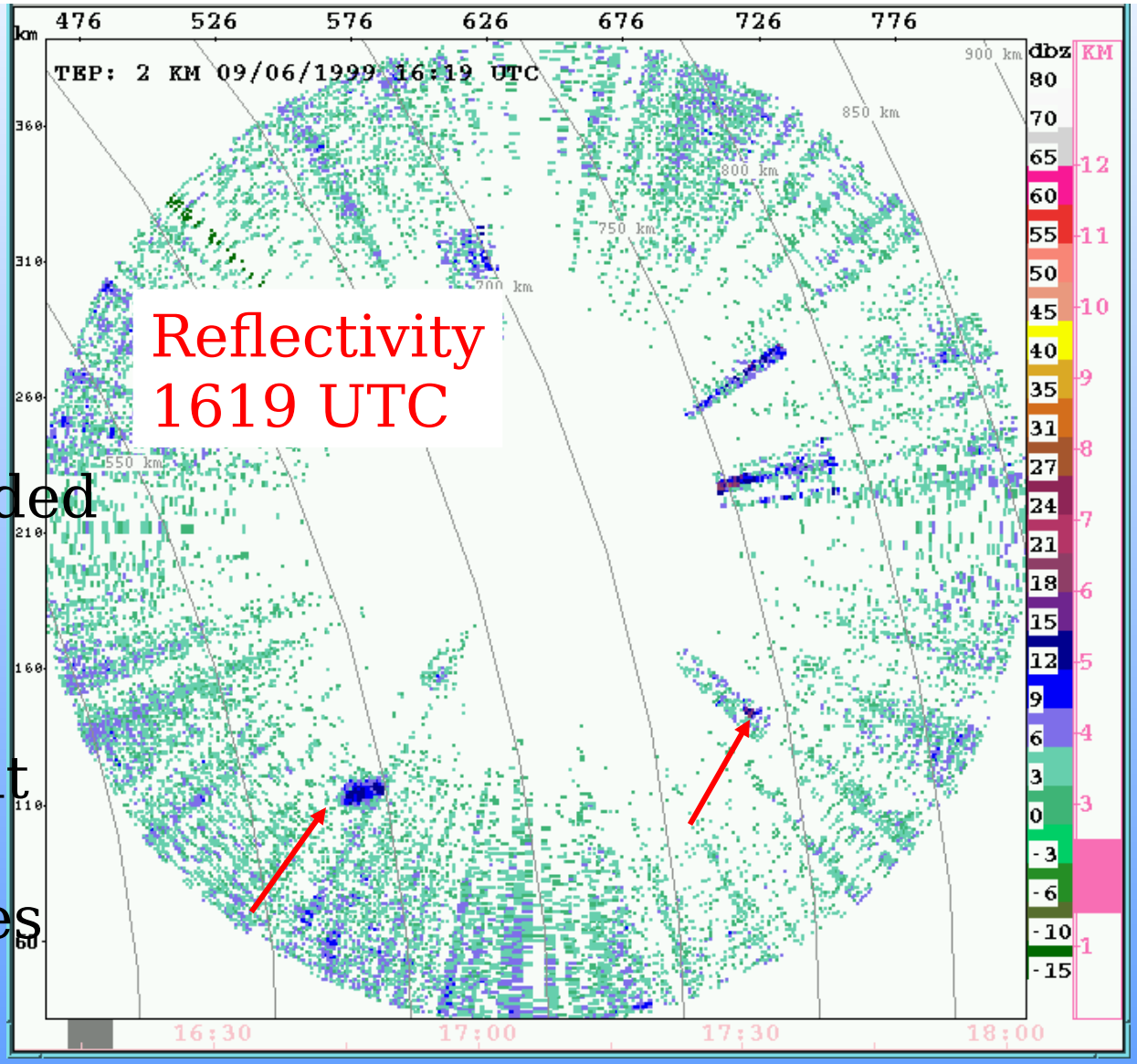

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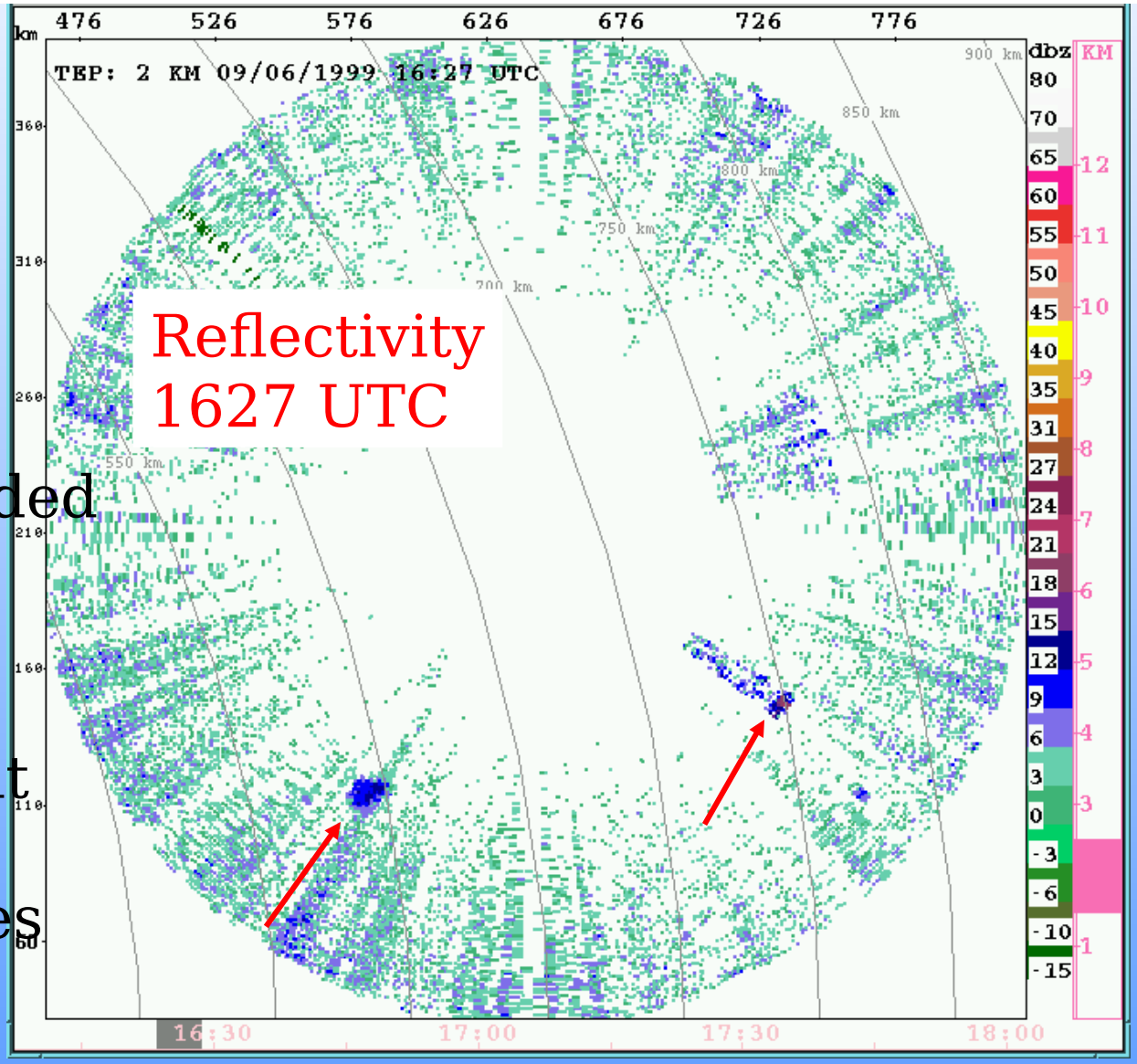
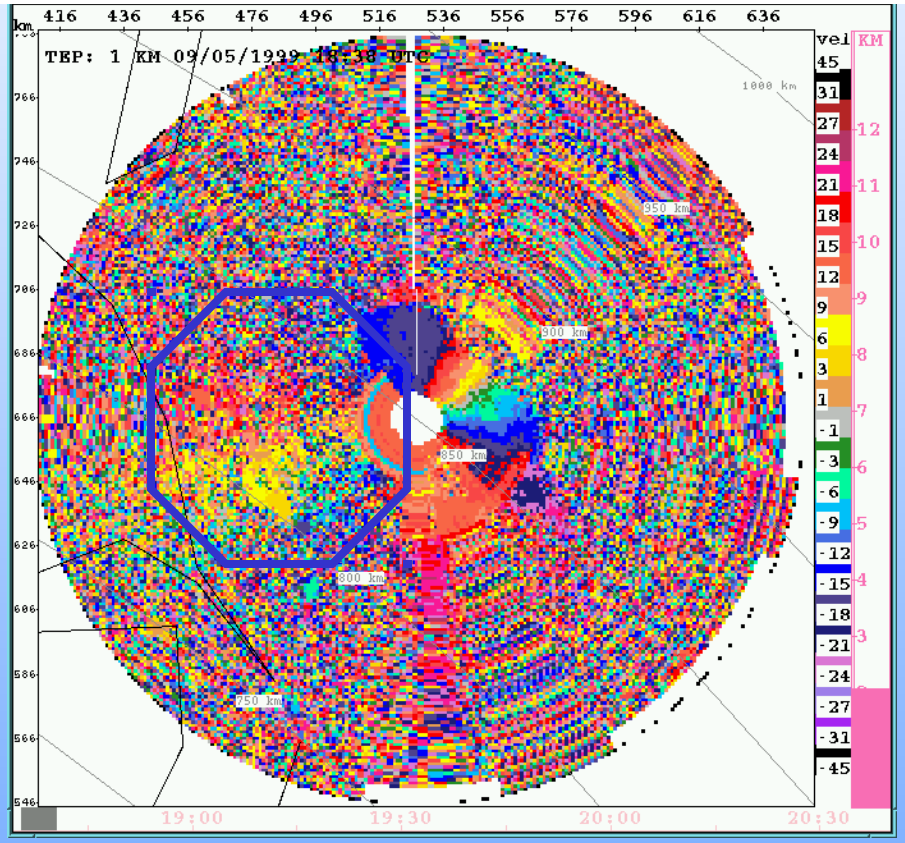
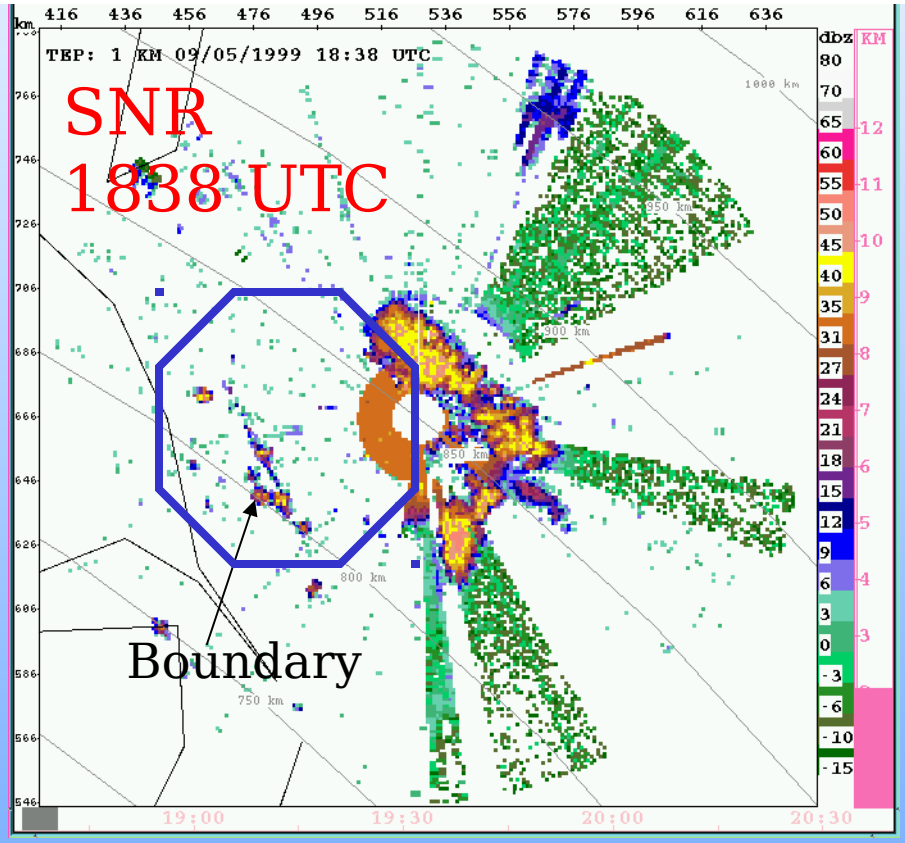


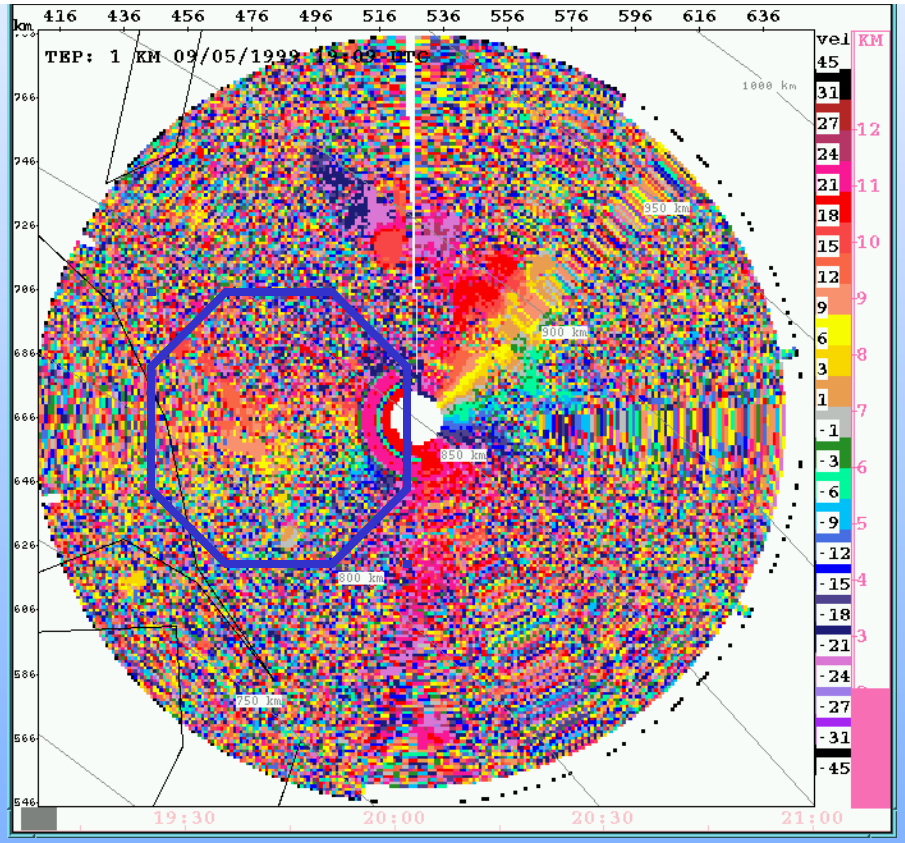
Wind Flow

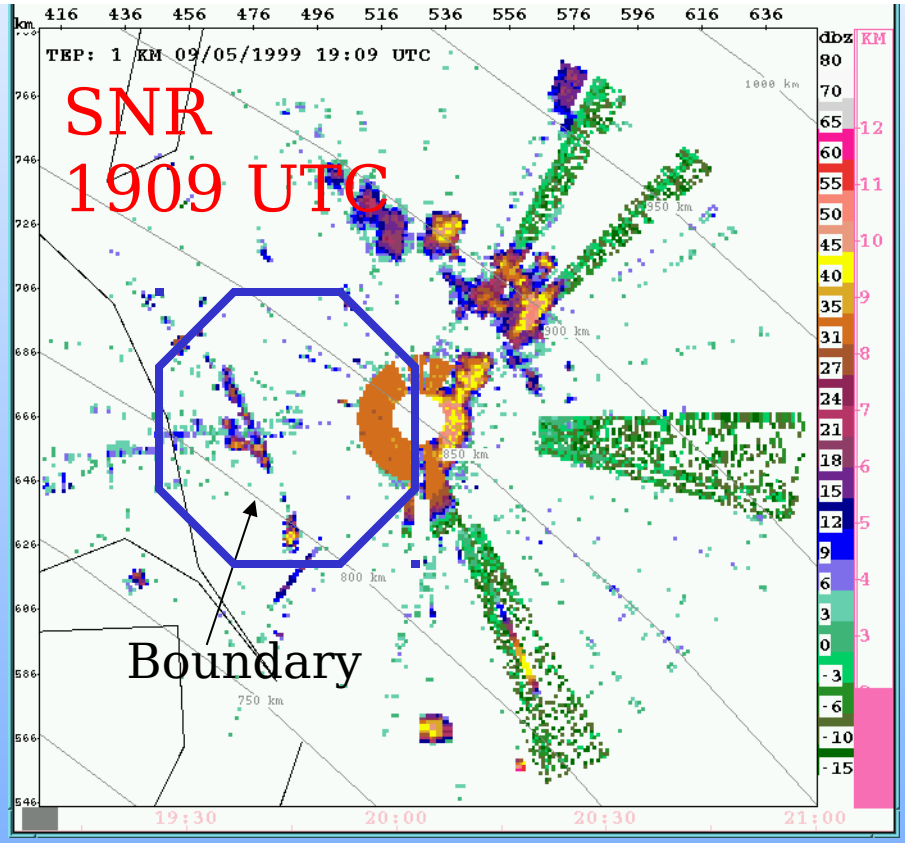




Good radial velocity field in “clear air” over ocean. Wha
(assuming correct ship position)
Possibly an outer band of Hurricane Dennis

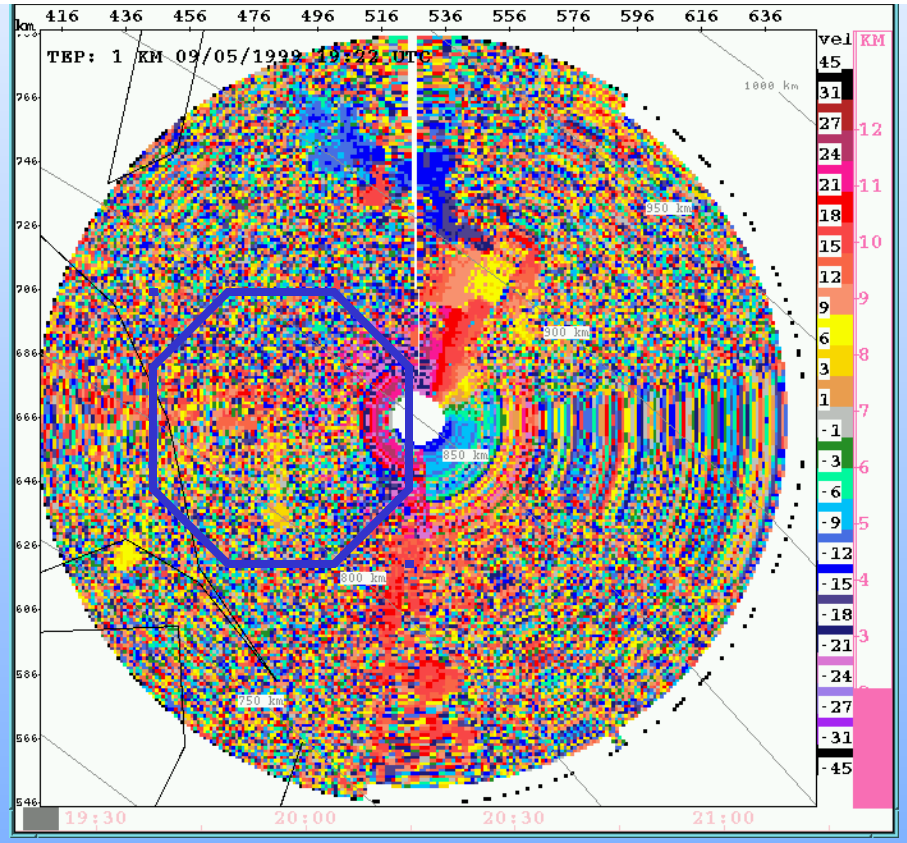
Wind Flow

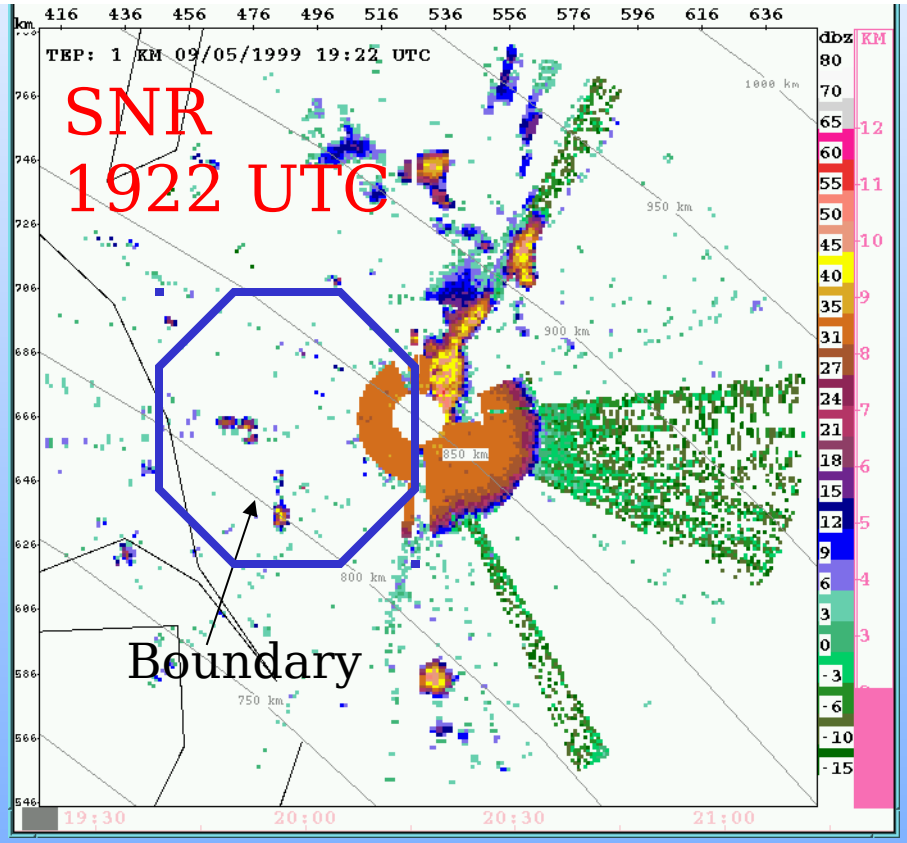




Good radial velocity field in “clear air” over ocean. Wha
(assuming correct ship position)
Possibly an outer band of Hurricane Dennis

Wind Flow





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Possibly an outer band of Hurricane Dennis

Precipitation Cases

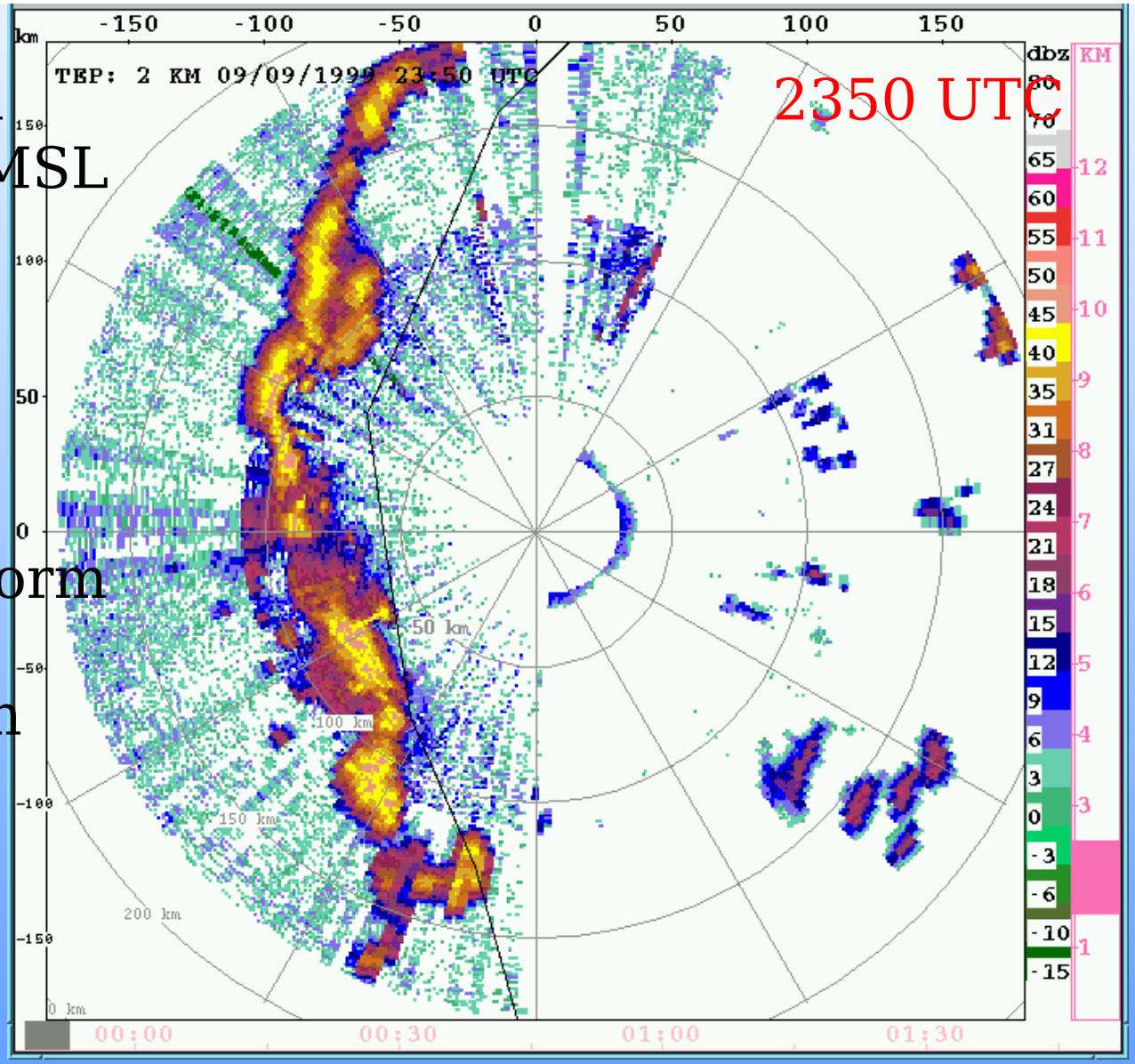
- Jacksonville, FL most complete case
  - About 3 hours of data
  - Volumes 5-15 min apart
  - TITAN algorithm produces 30 min forecasts of extrapolated position of storm

September 9-10, 1999

Reflectivity field shown at 2 km MSL

Range rings at 50 km intervals

TITAN polygons
cyan: current storm position
magenta: 30 min forecasted position



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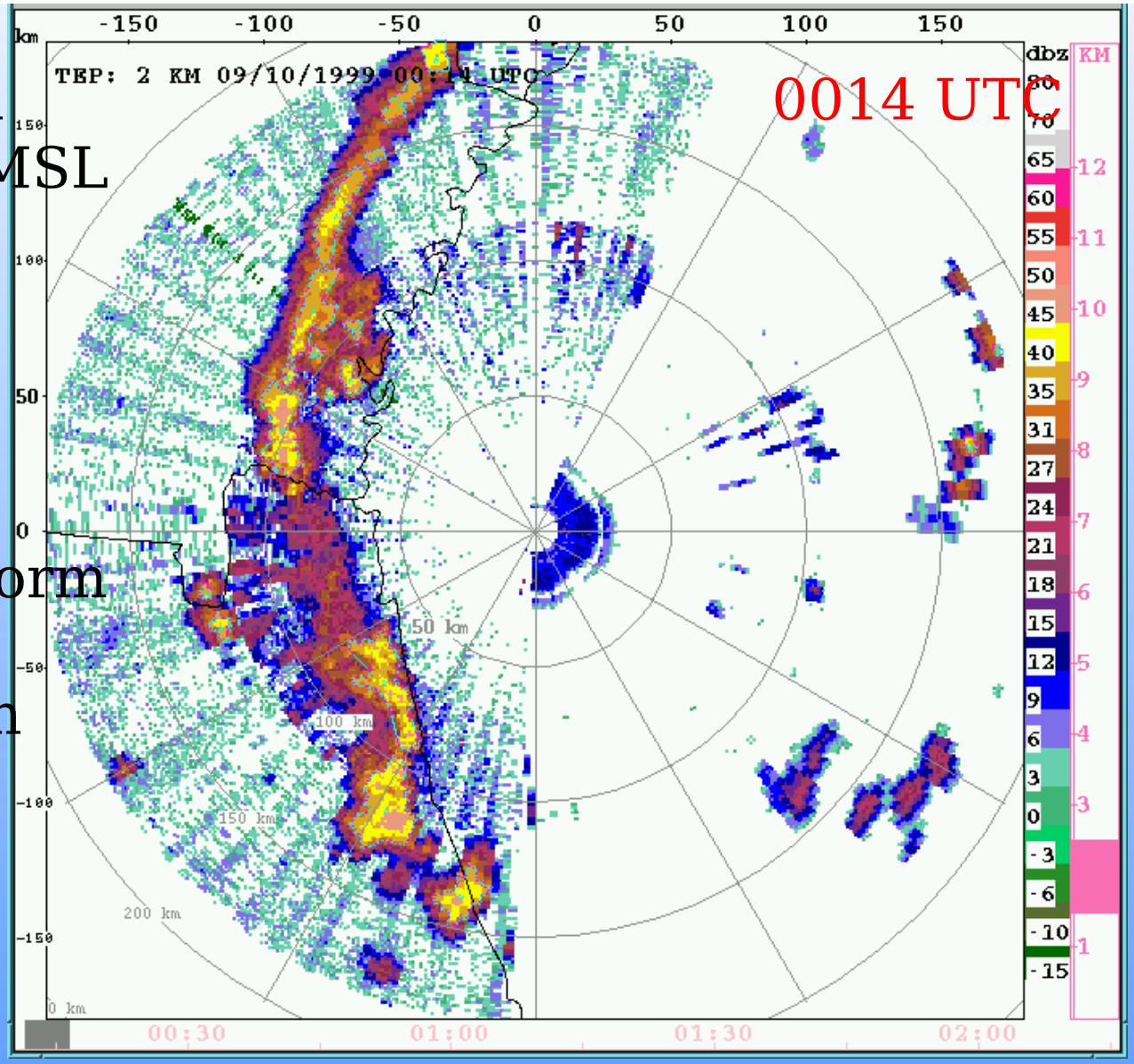

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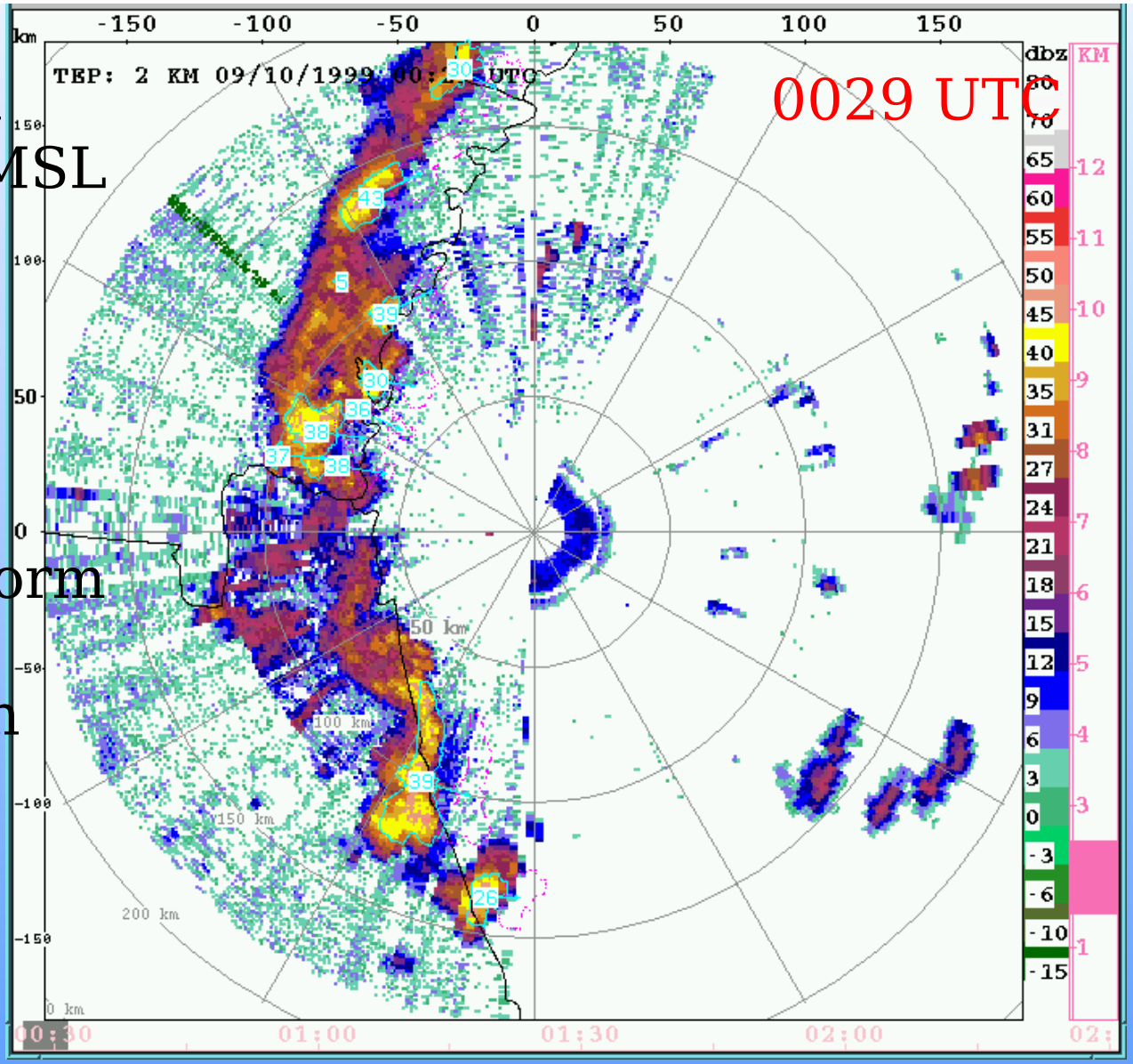

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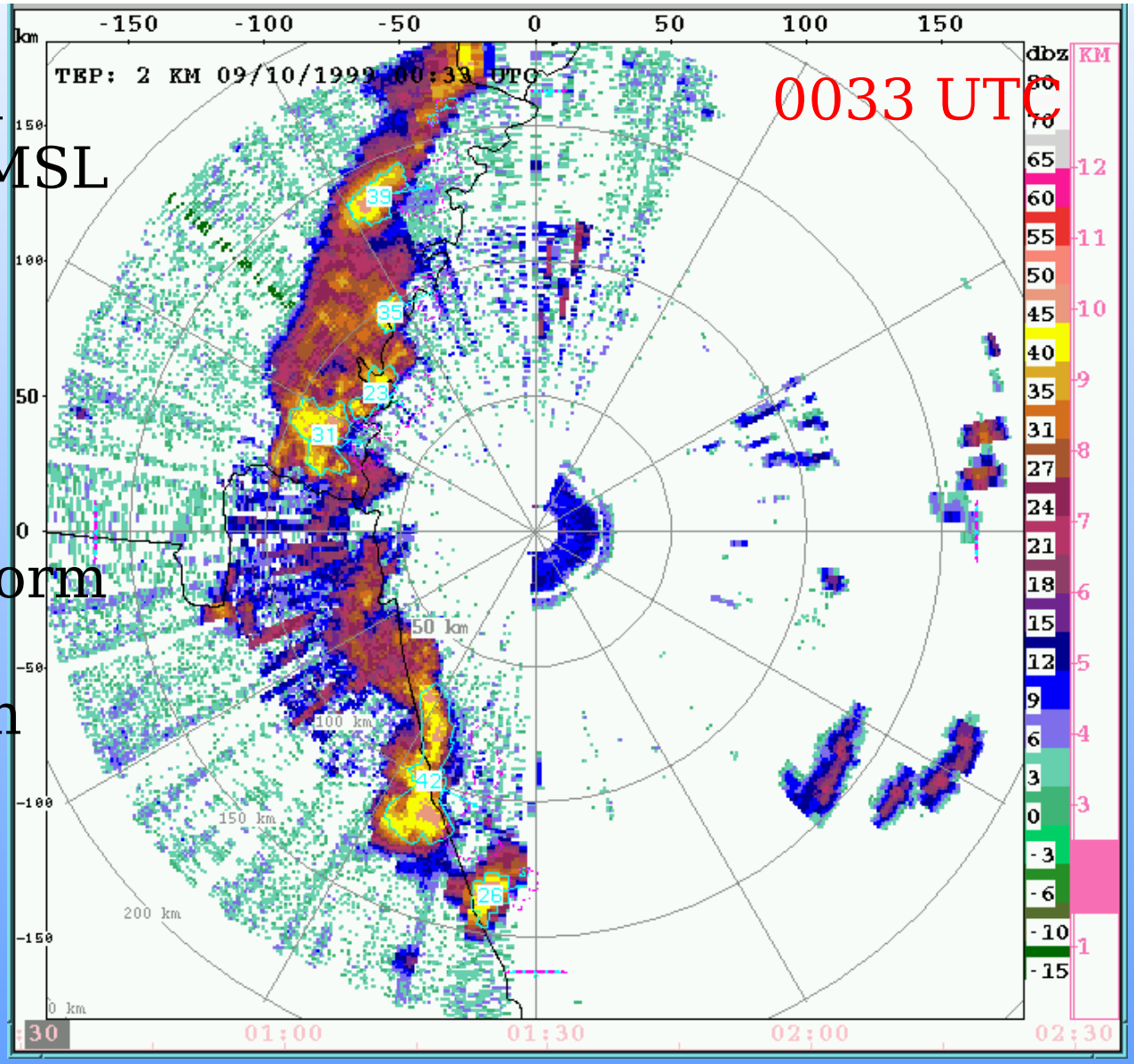

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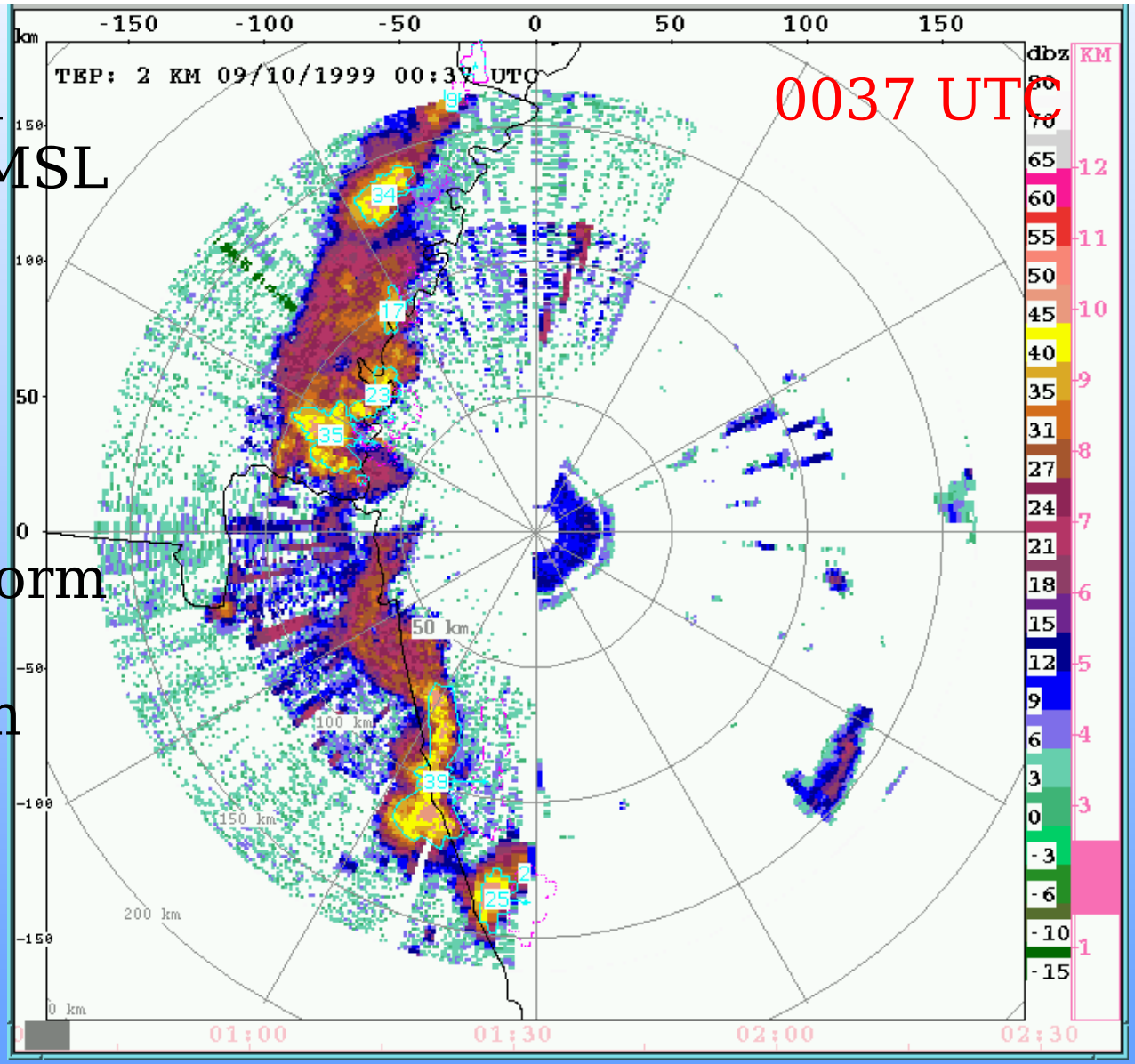

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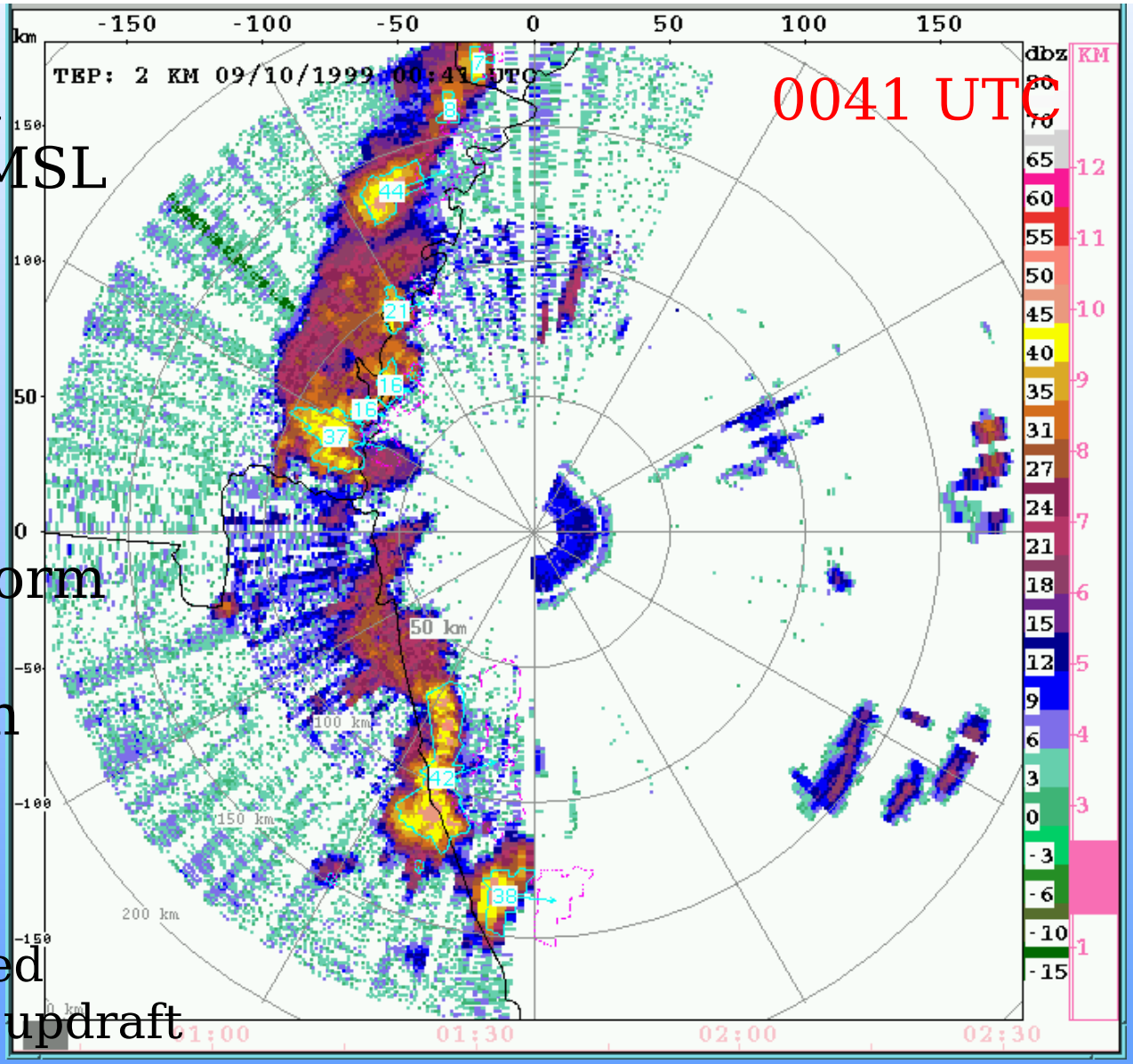
Arcus clearly defined and detached from updraft



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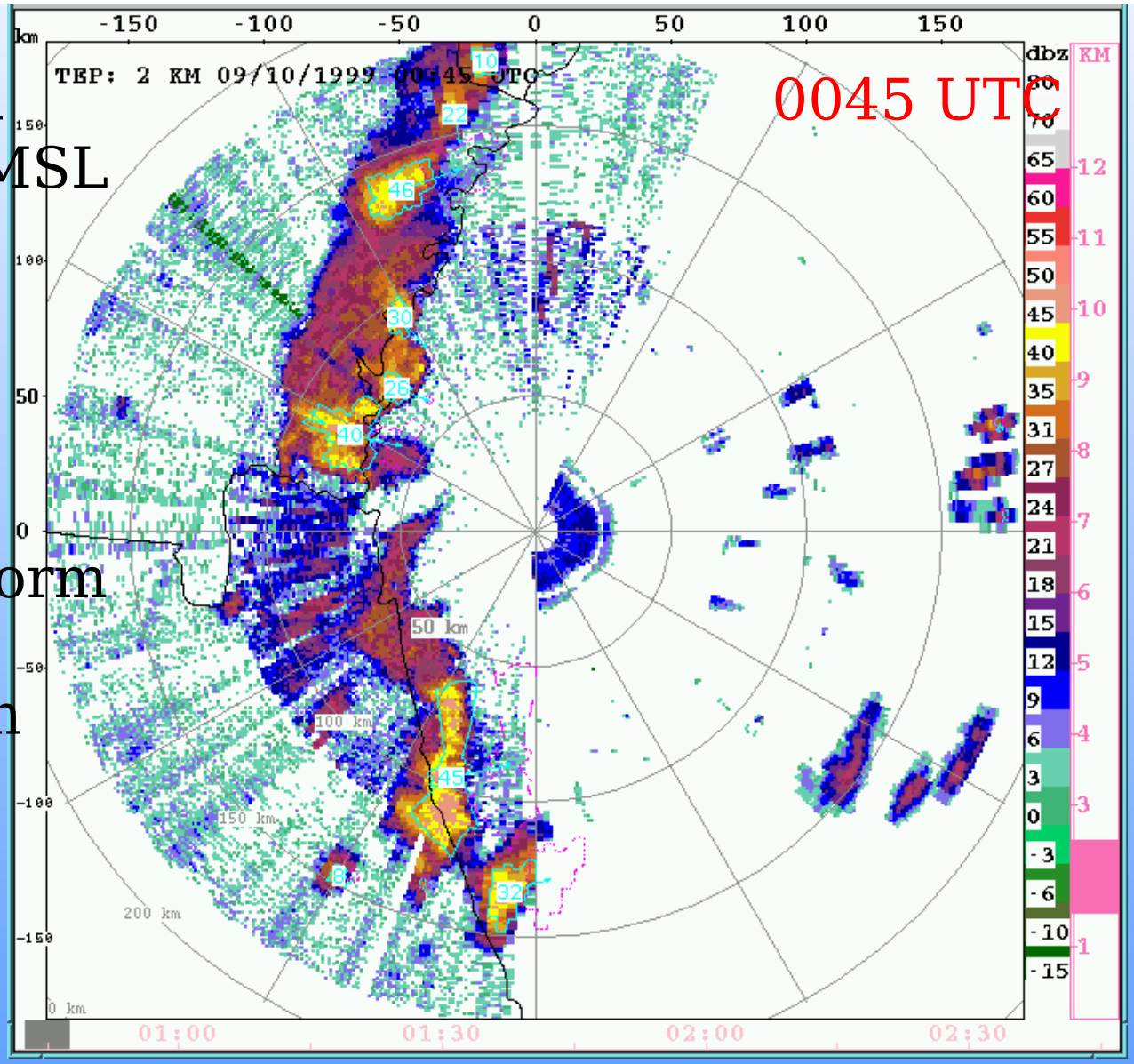

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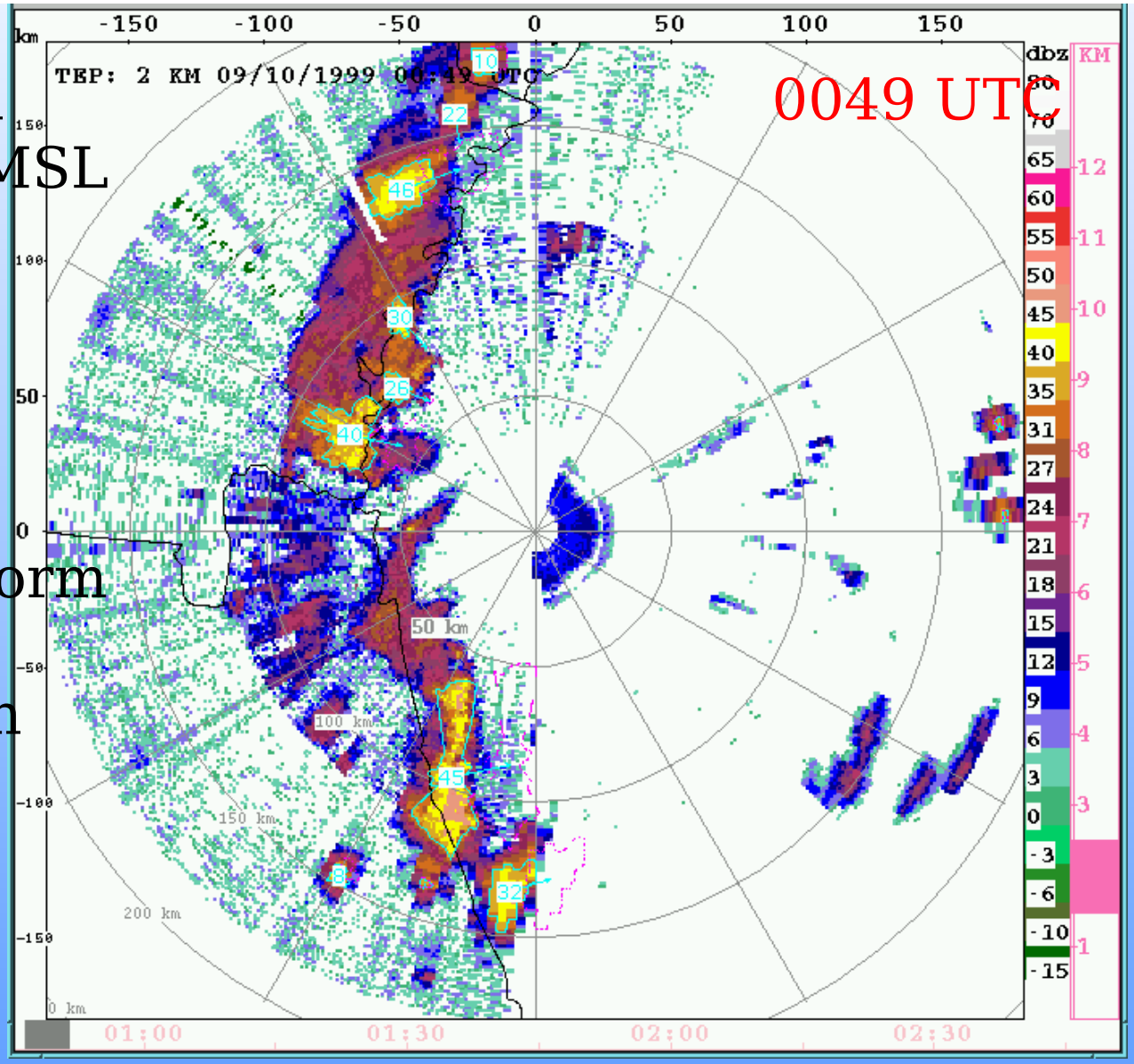

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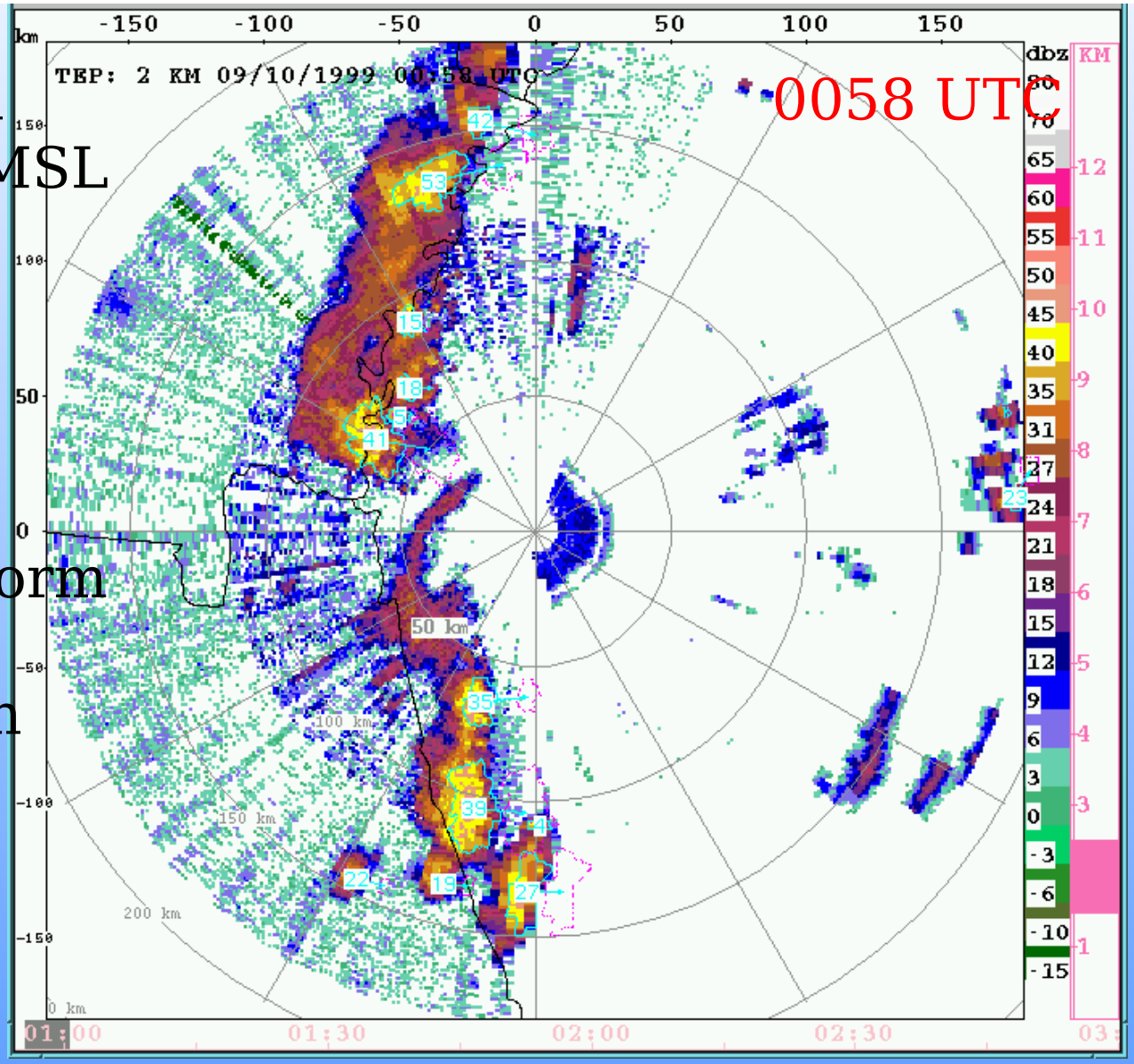

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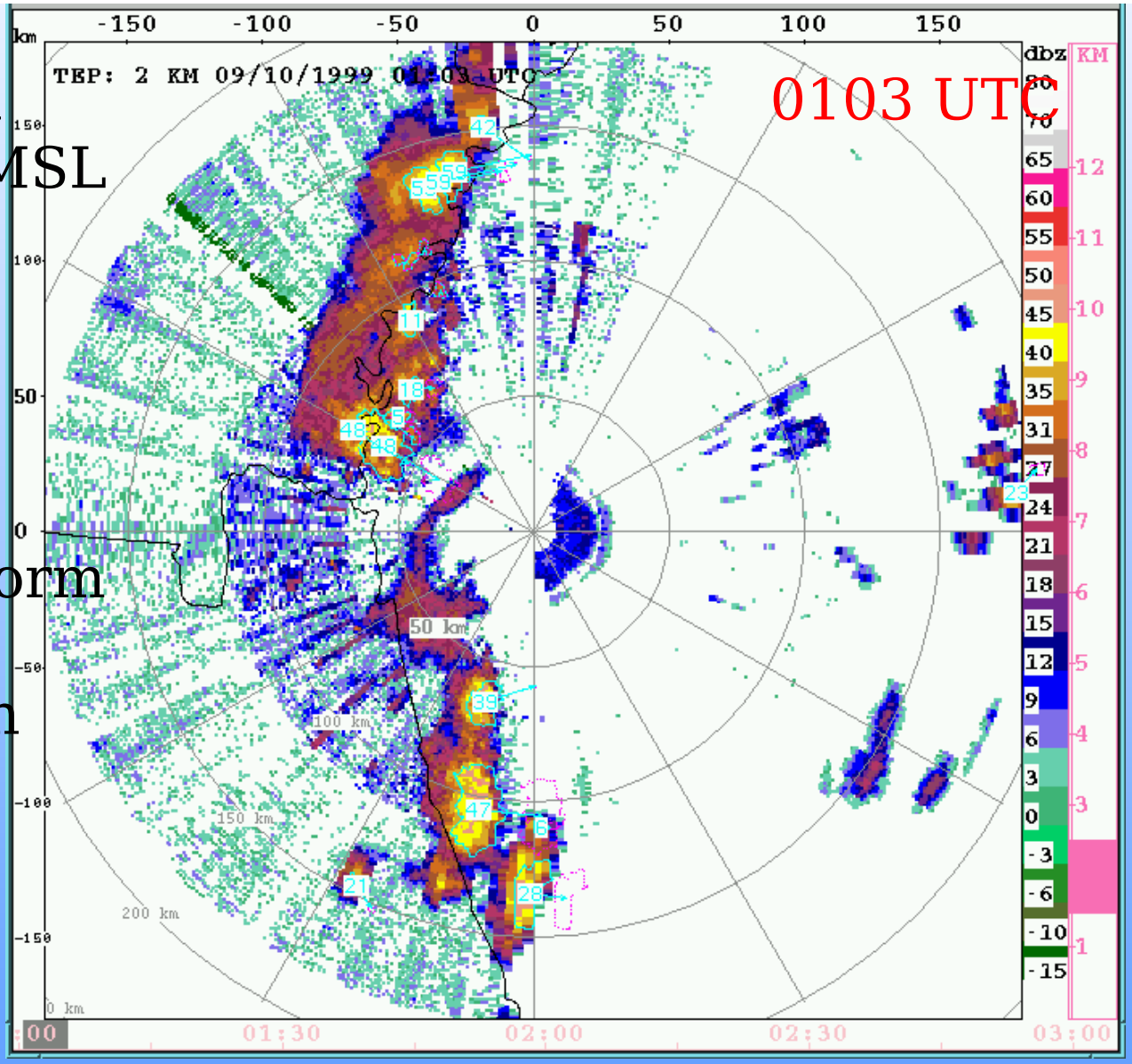

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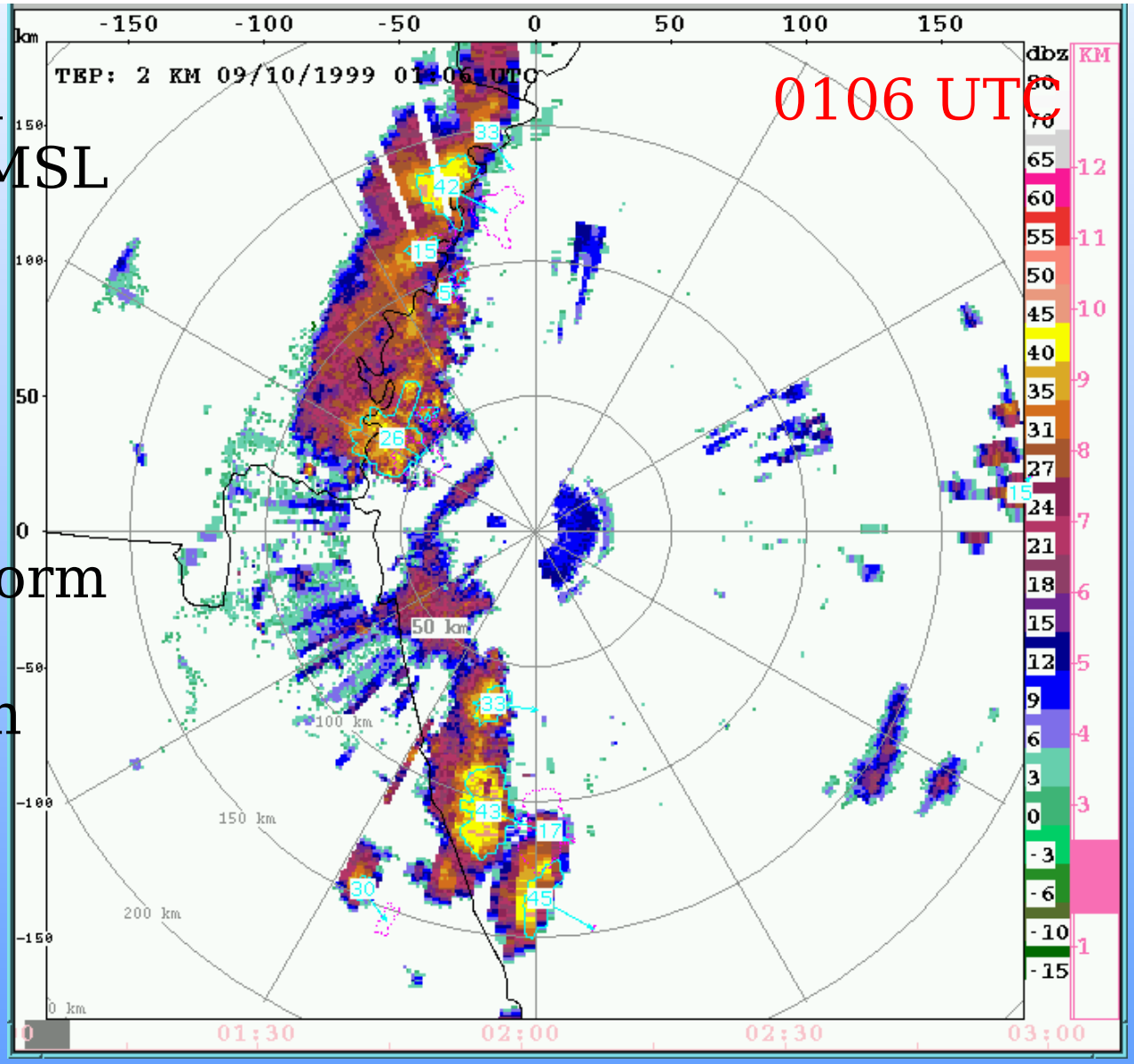

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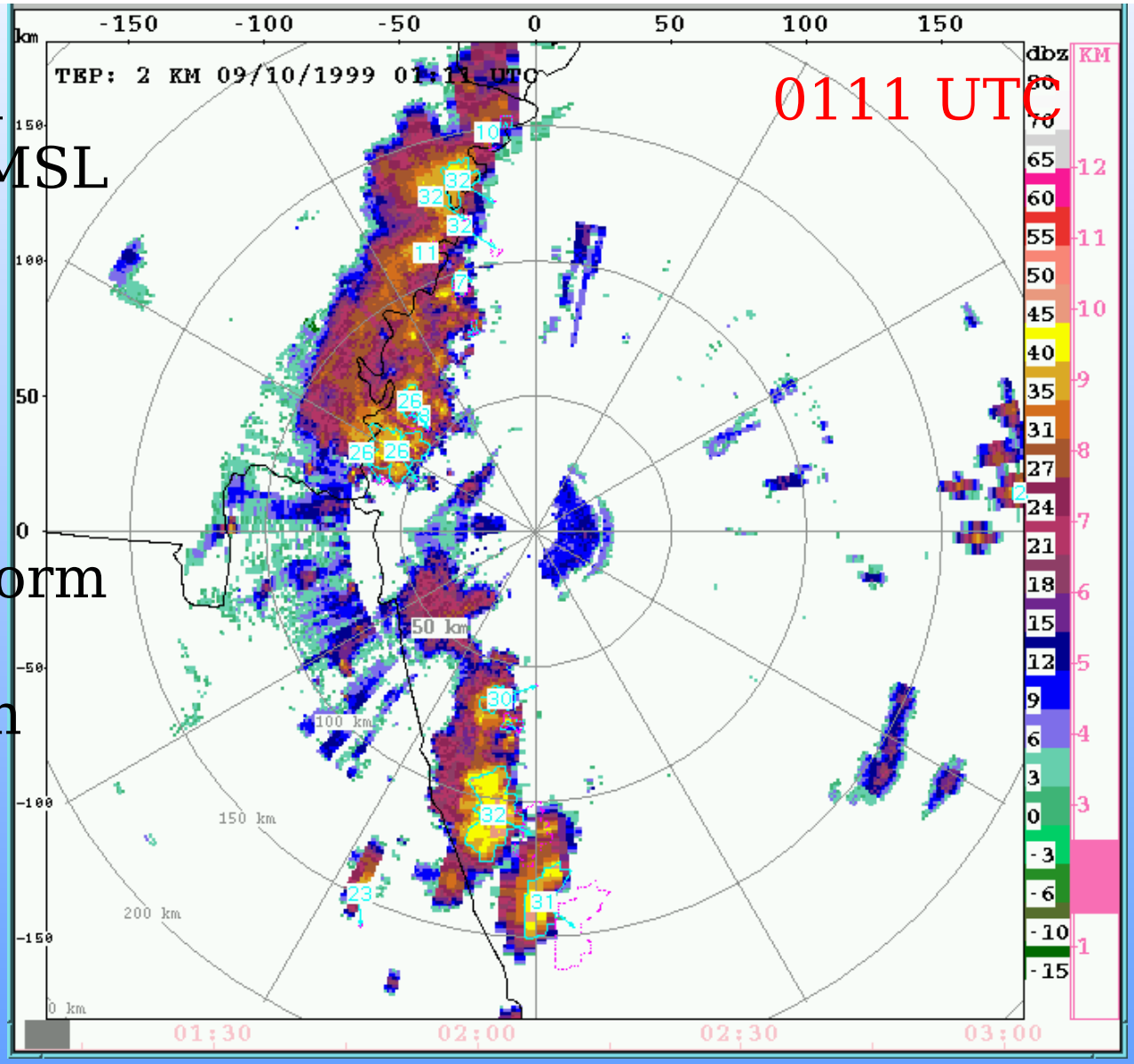

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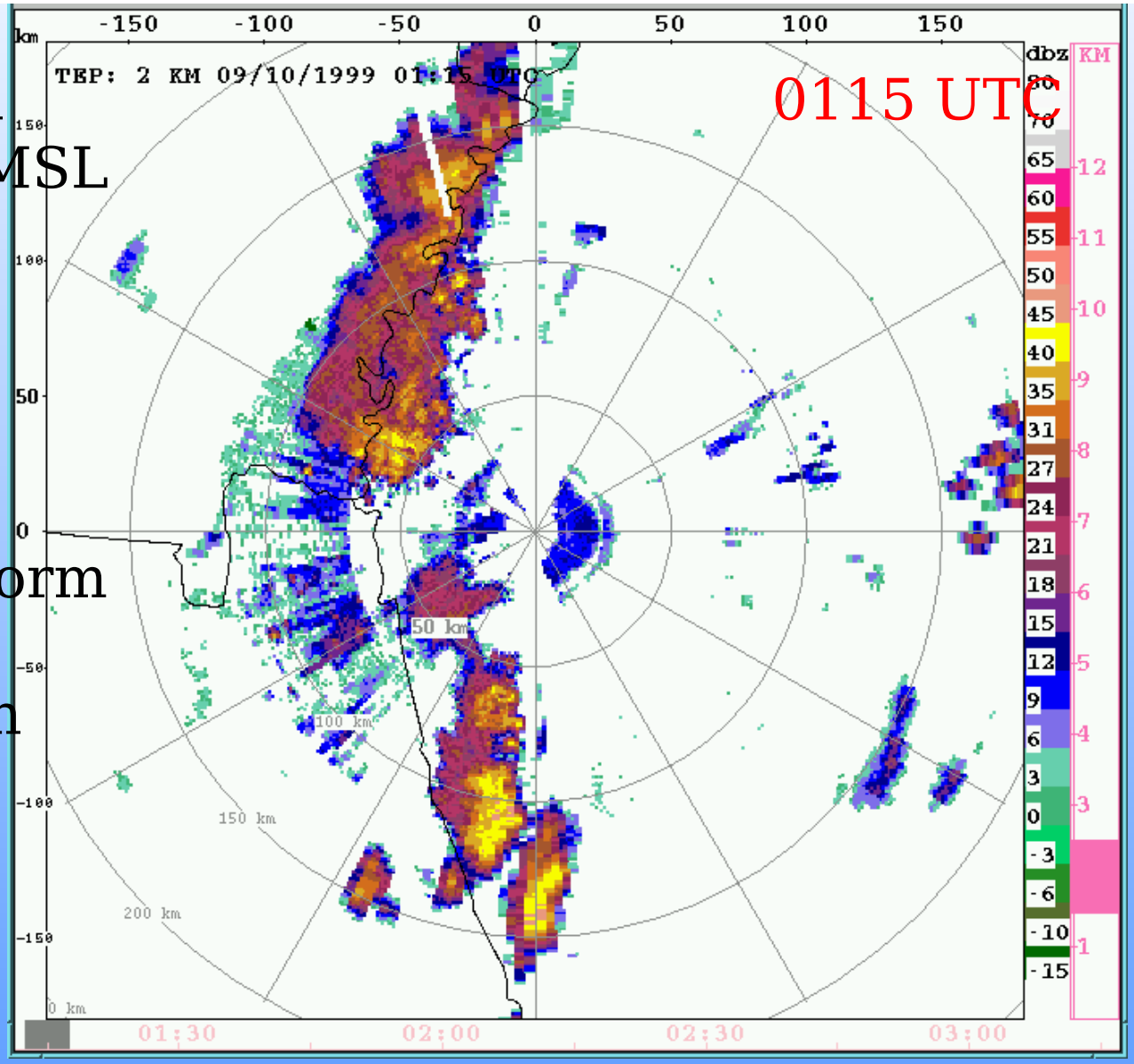

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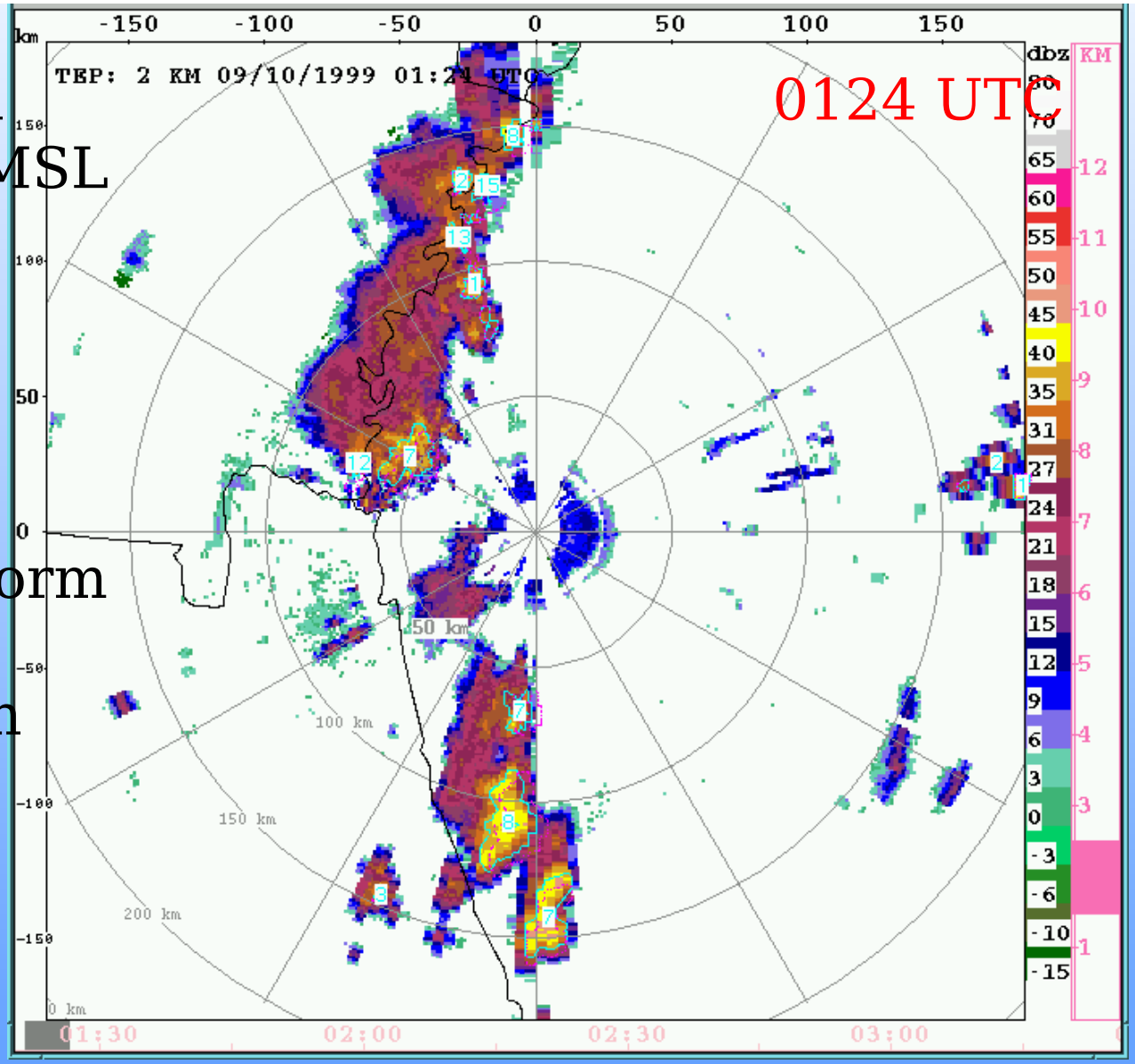

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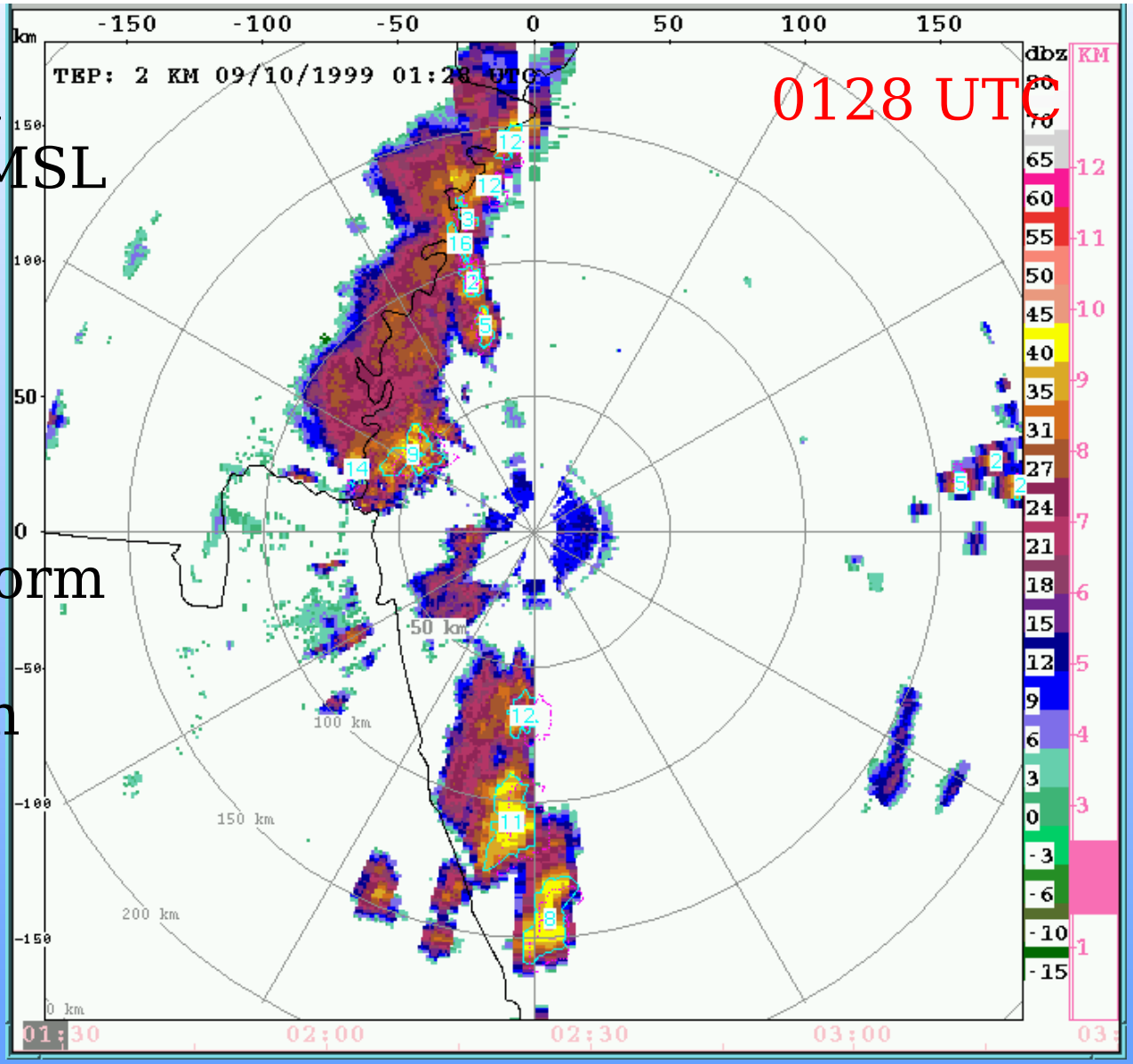

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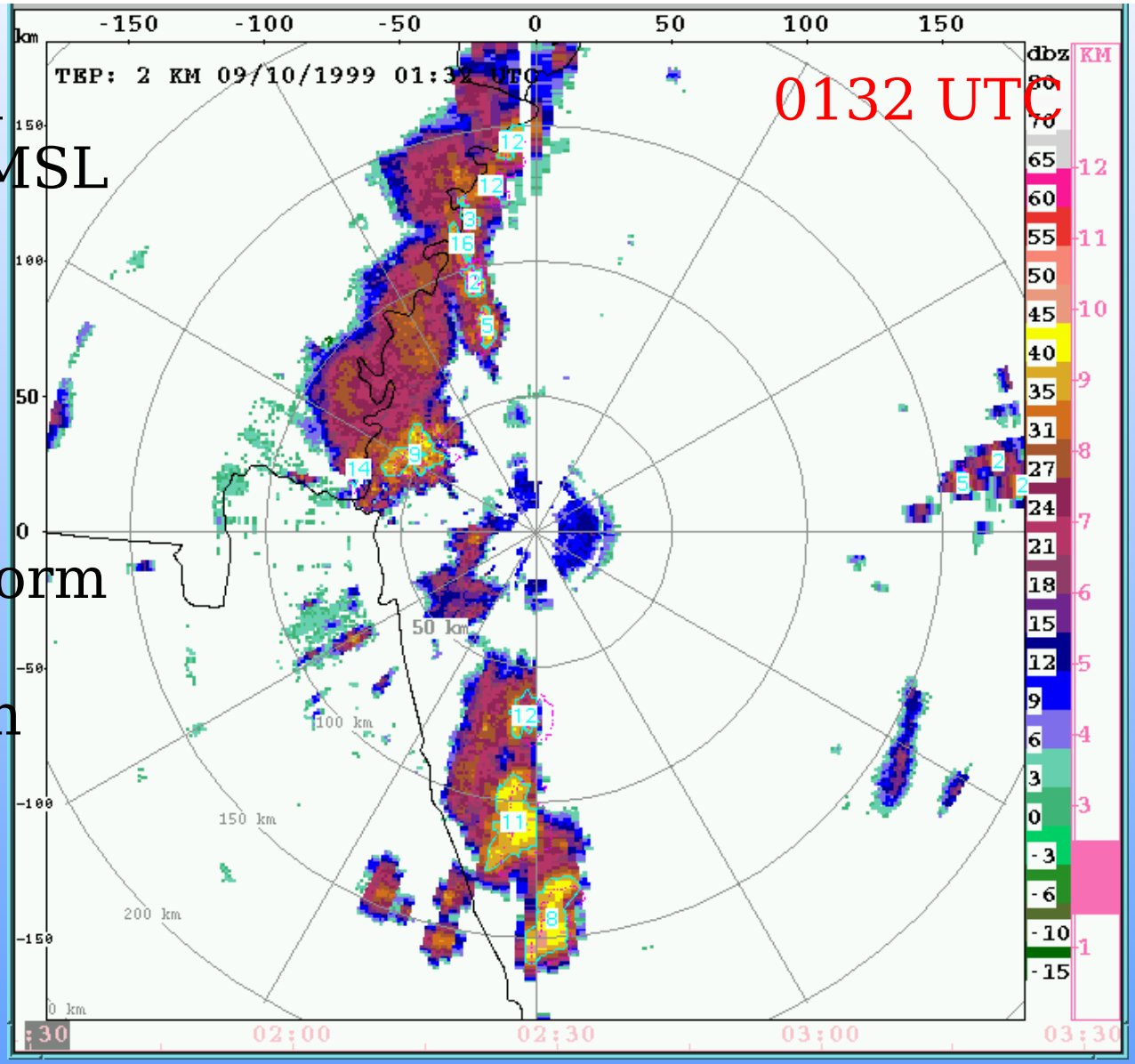

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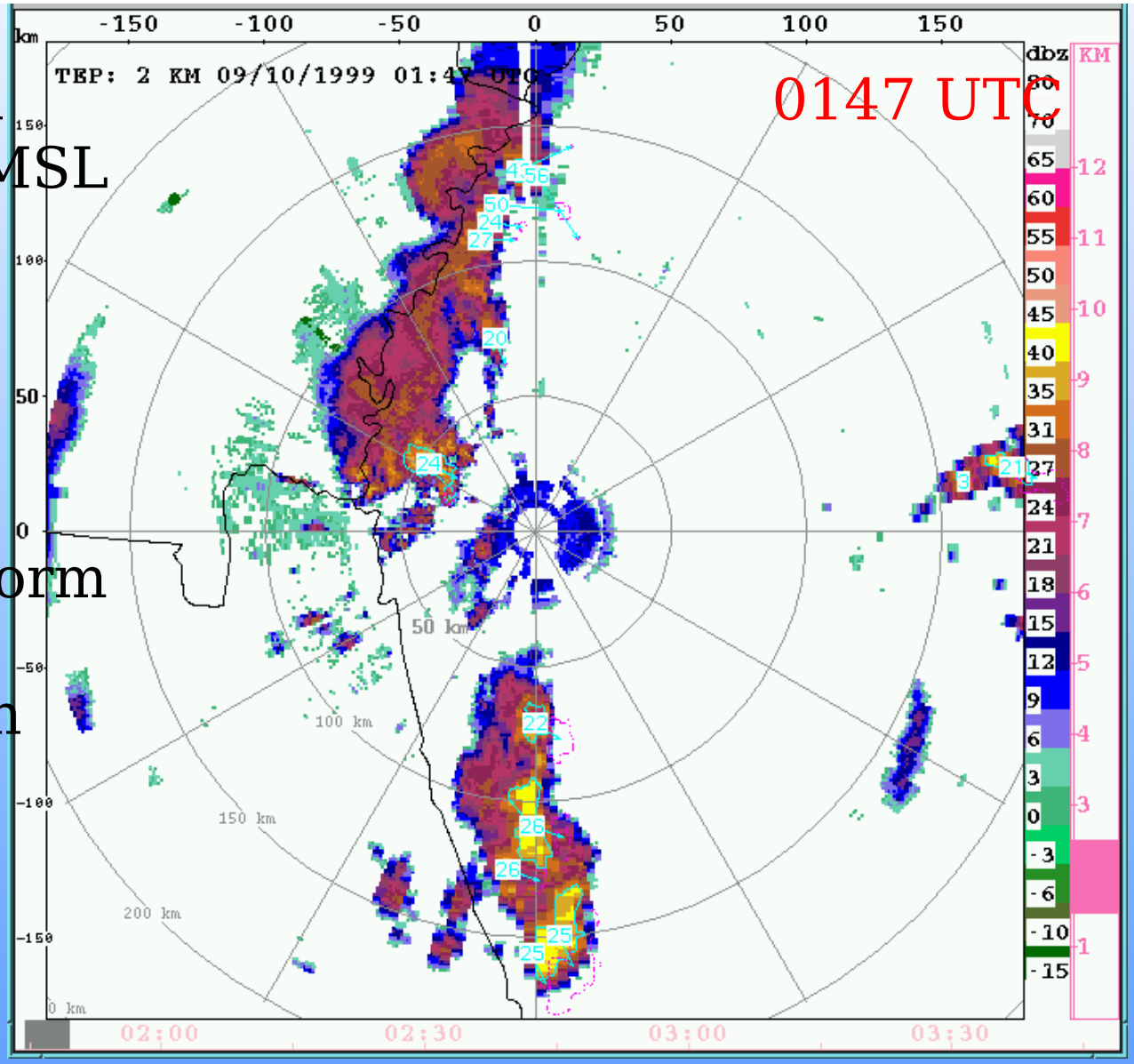

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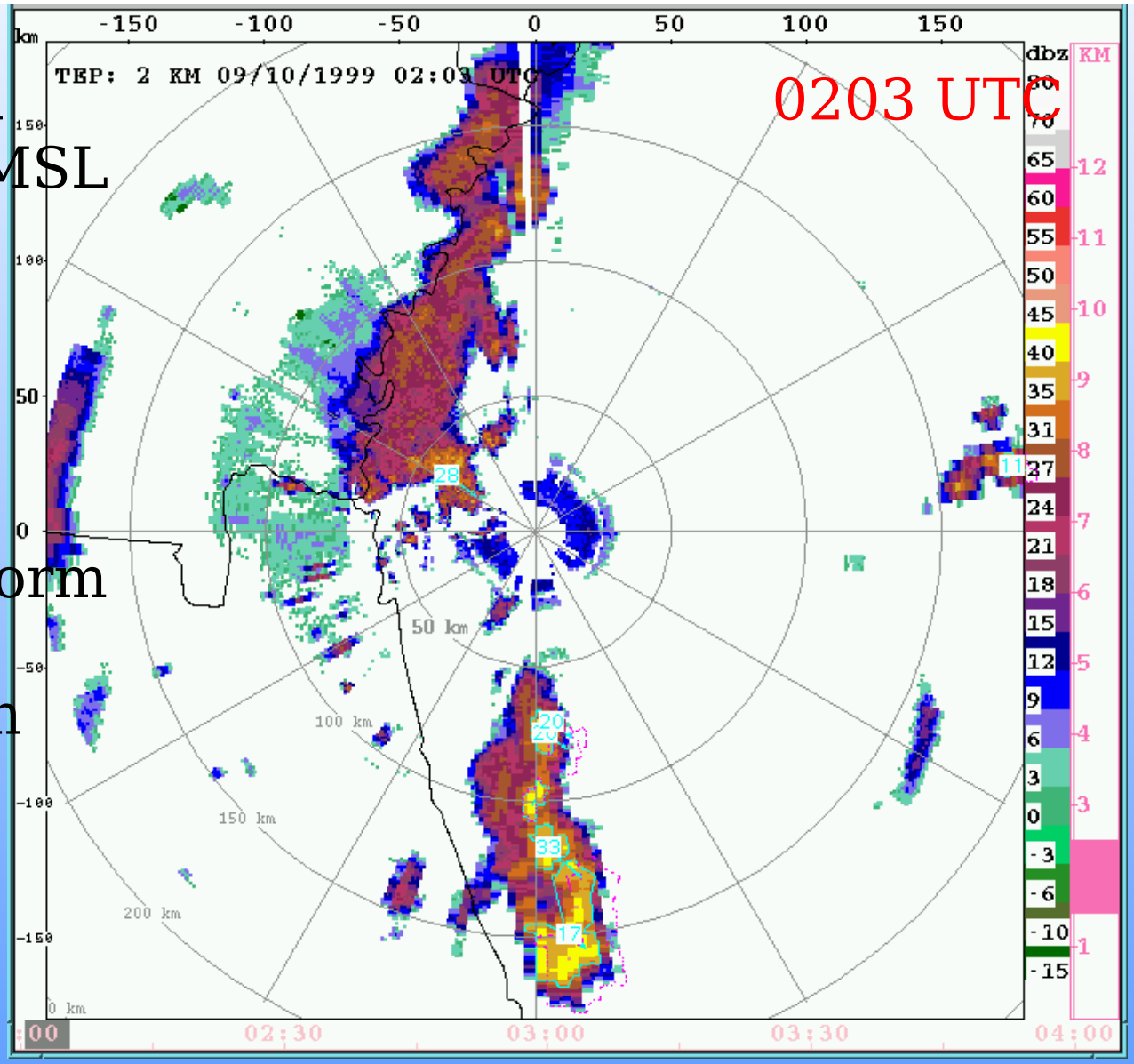

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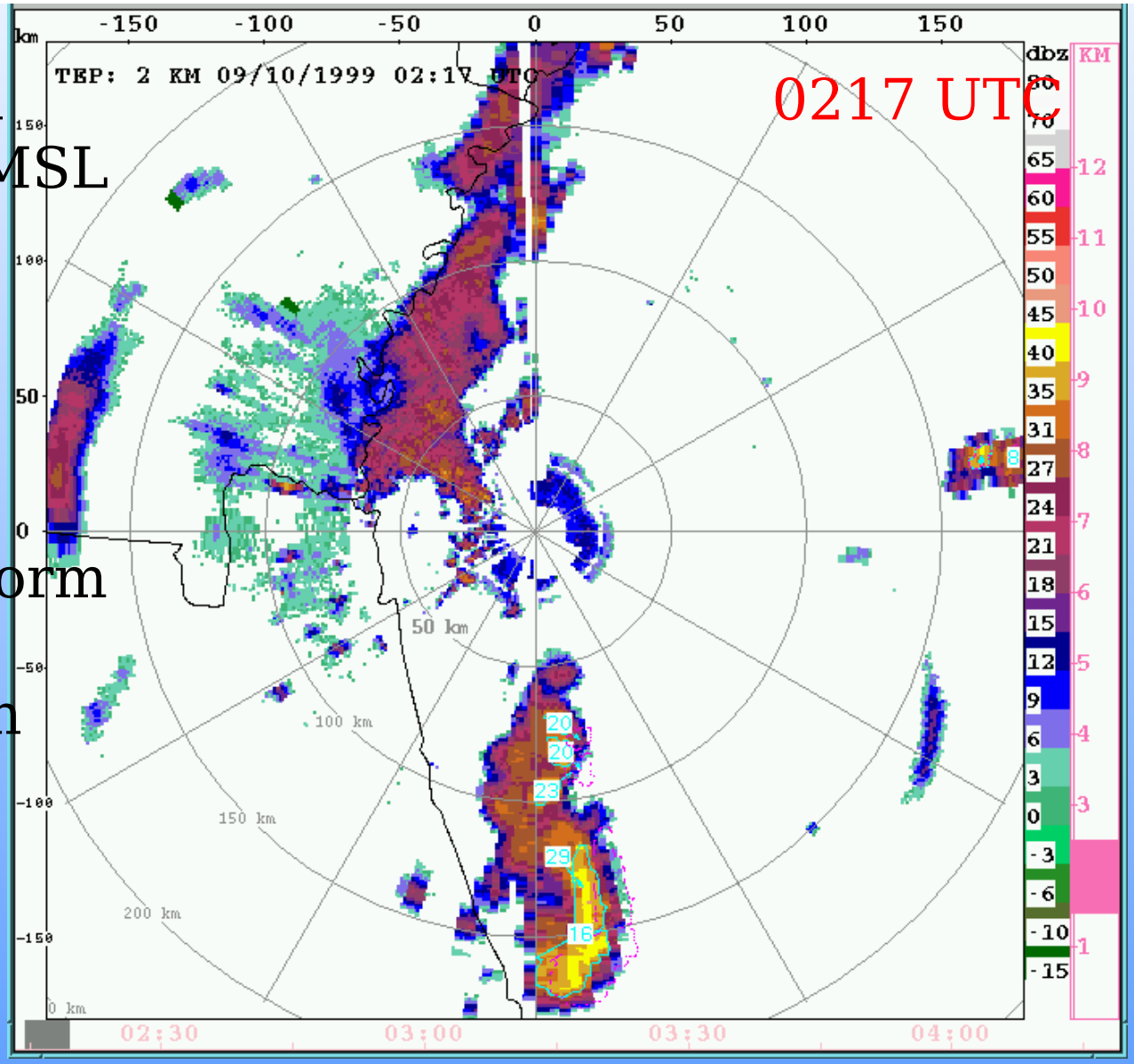

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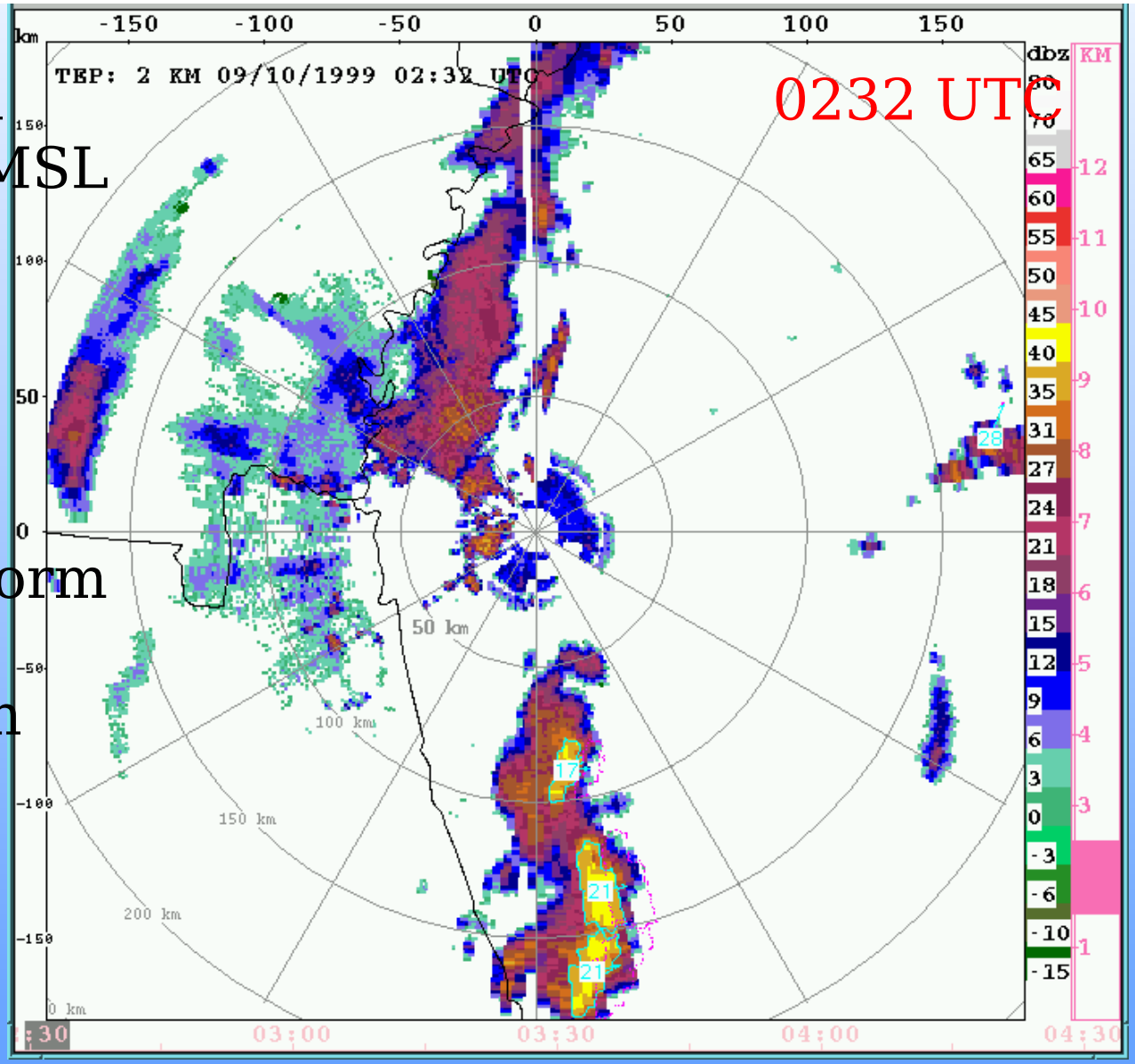

TITAN

Reflectivity field shown at 1 km MSL

Range rings at 10 km intervals

TITAN polygons
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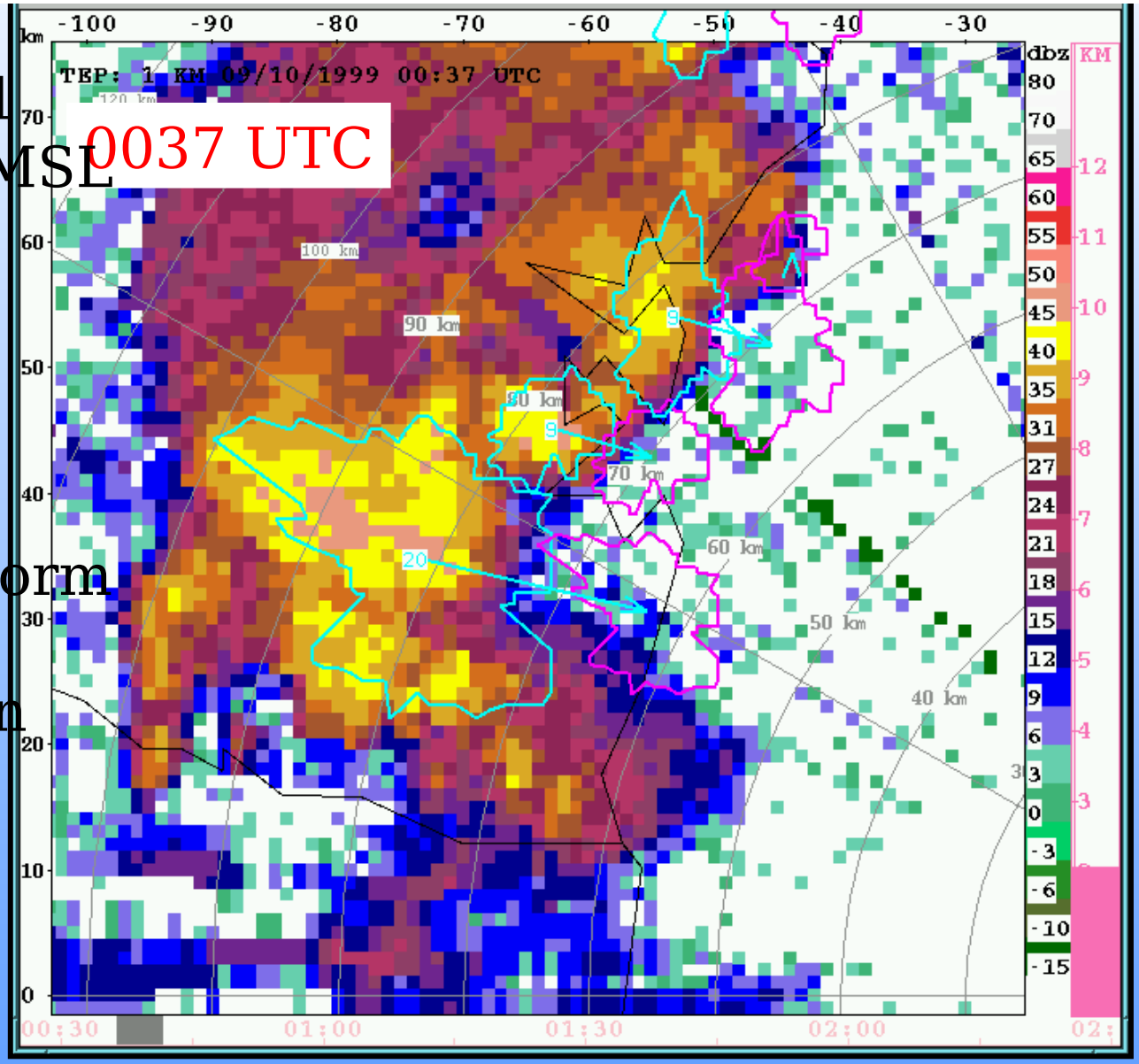
Forecast



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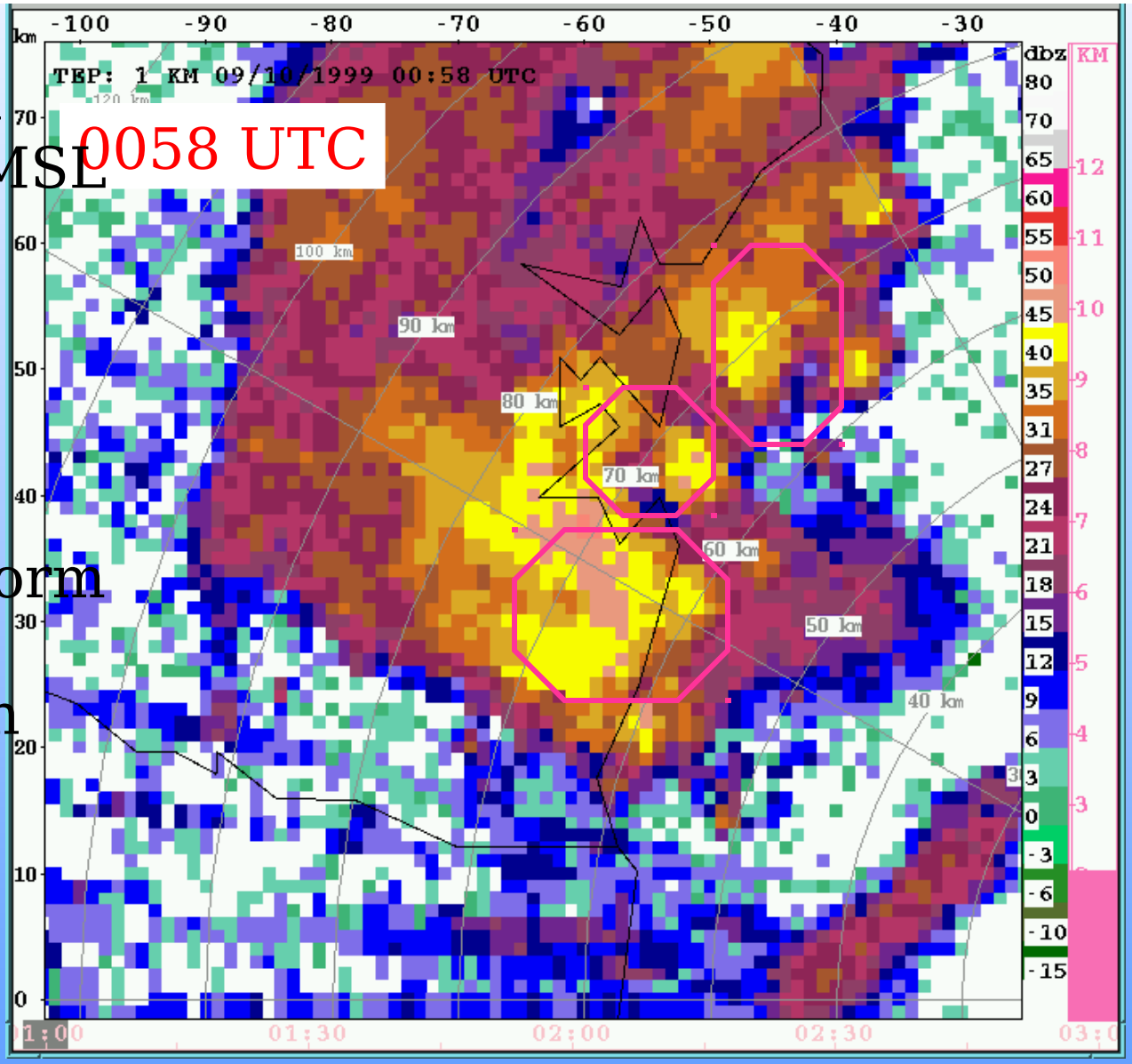
Validation



Data Quality Issues

- Ground clutter
- Sea clutter
- Second trip echo
- Dealiasing radial velocity
- Beam glitches

NEXRAD Data Quality Program

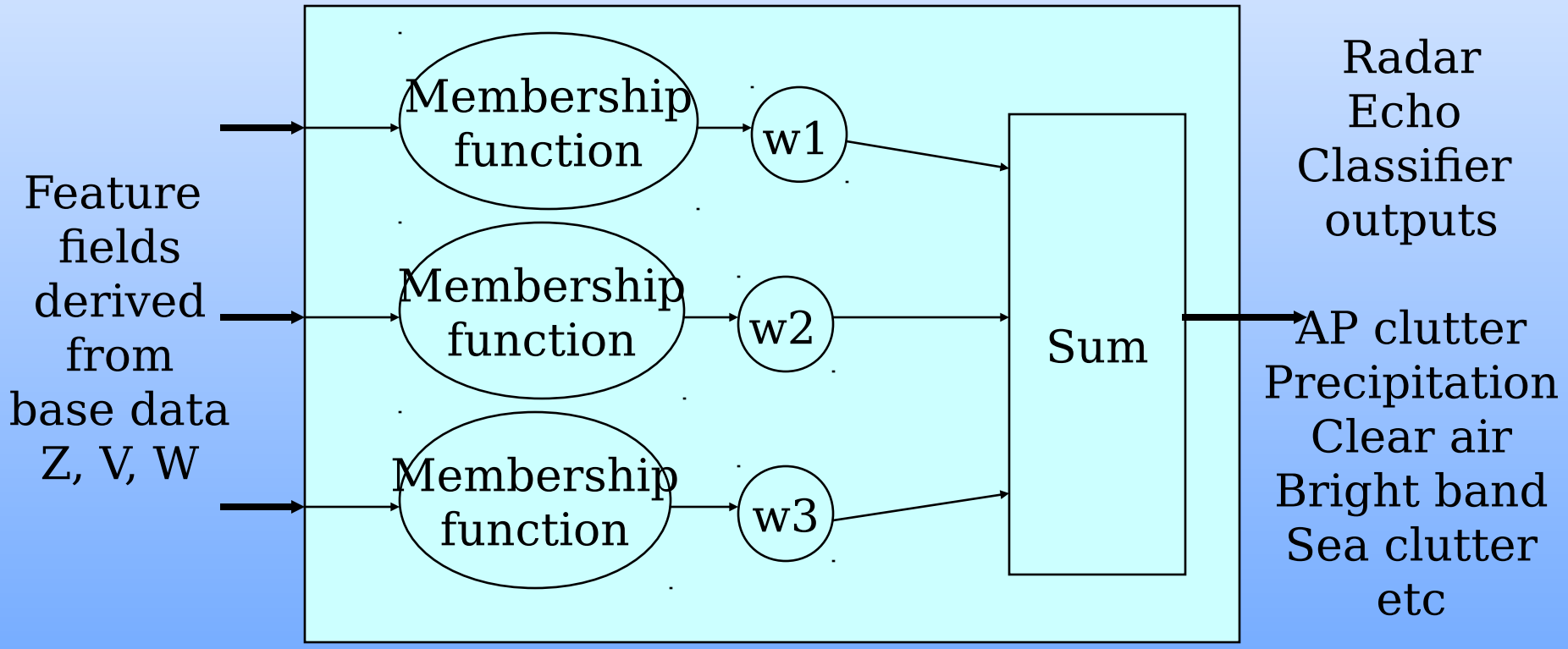
- NCAR working with NOAA OSF to improve data quality of WSR-88D
- AP clutter is significant problem
  - Creates errors in hydrologic algorithms that estimate rainfall from radar
  - Other algorithms are effected, too
  - Leads to errors in interpretation of base data
- Very important to remove AP clutter

AP Clutter Mitigation Scheme

- Automatic clutter filter control
- Radar Echo Classifier
  - Uses fuzzy logic techniques
  - AP Detection Algorithm (APDA)
  - Precipitation Detection Algorithm (PDA)
  - Clear Air Detection Algorithm (CADA)
  - other algorithms, as needed

Web page: http://www.atd.ucar.edu/rsf/NEXRAD

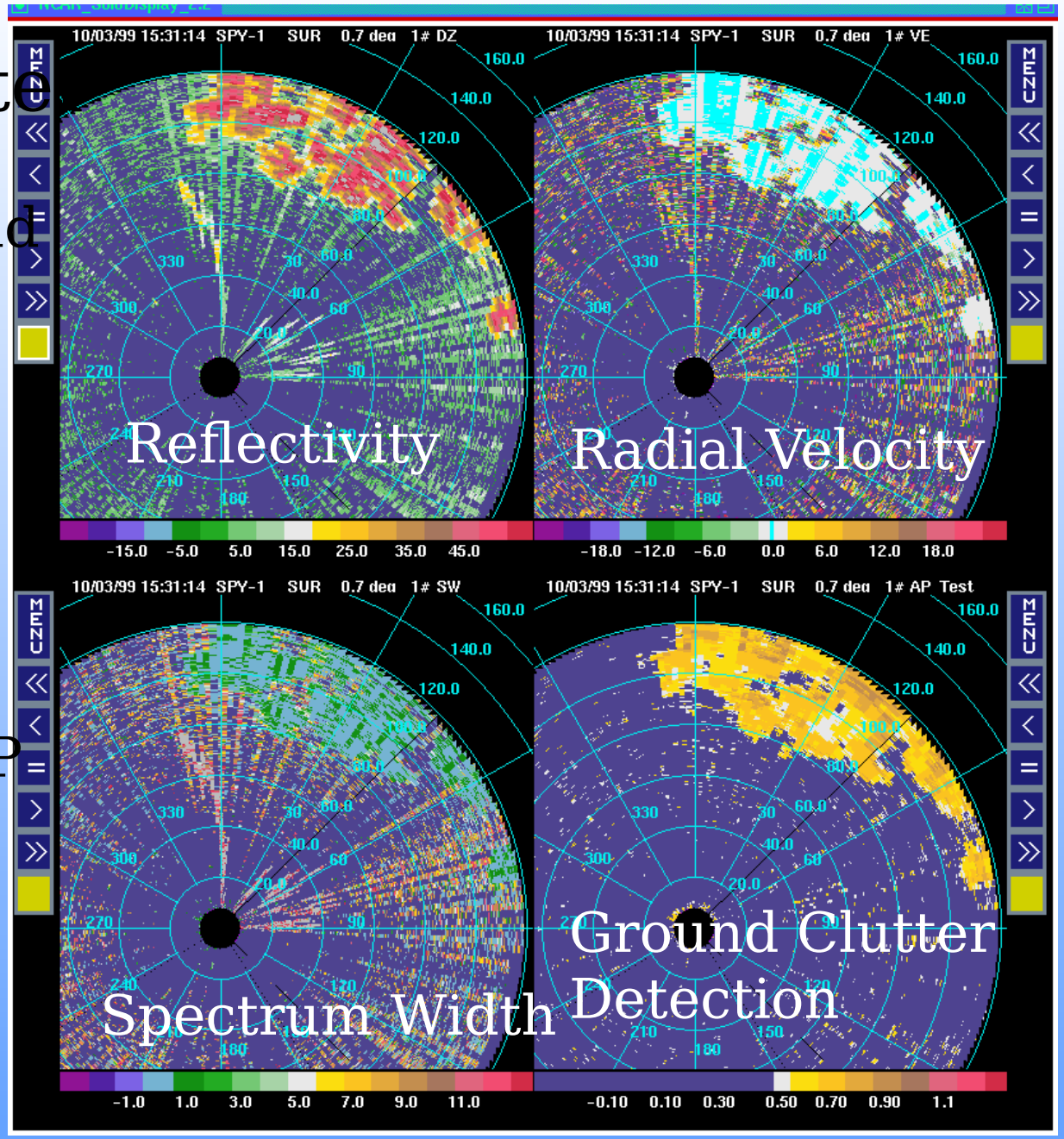
Fuzzy logic recognition



Ground Clutte

Plot shows ground clutter detection algorithm results using TEP data as input

No modifications made to the algorithm for TEP

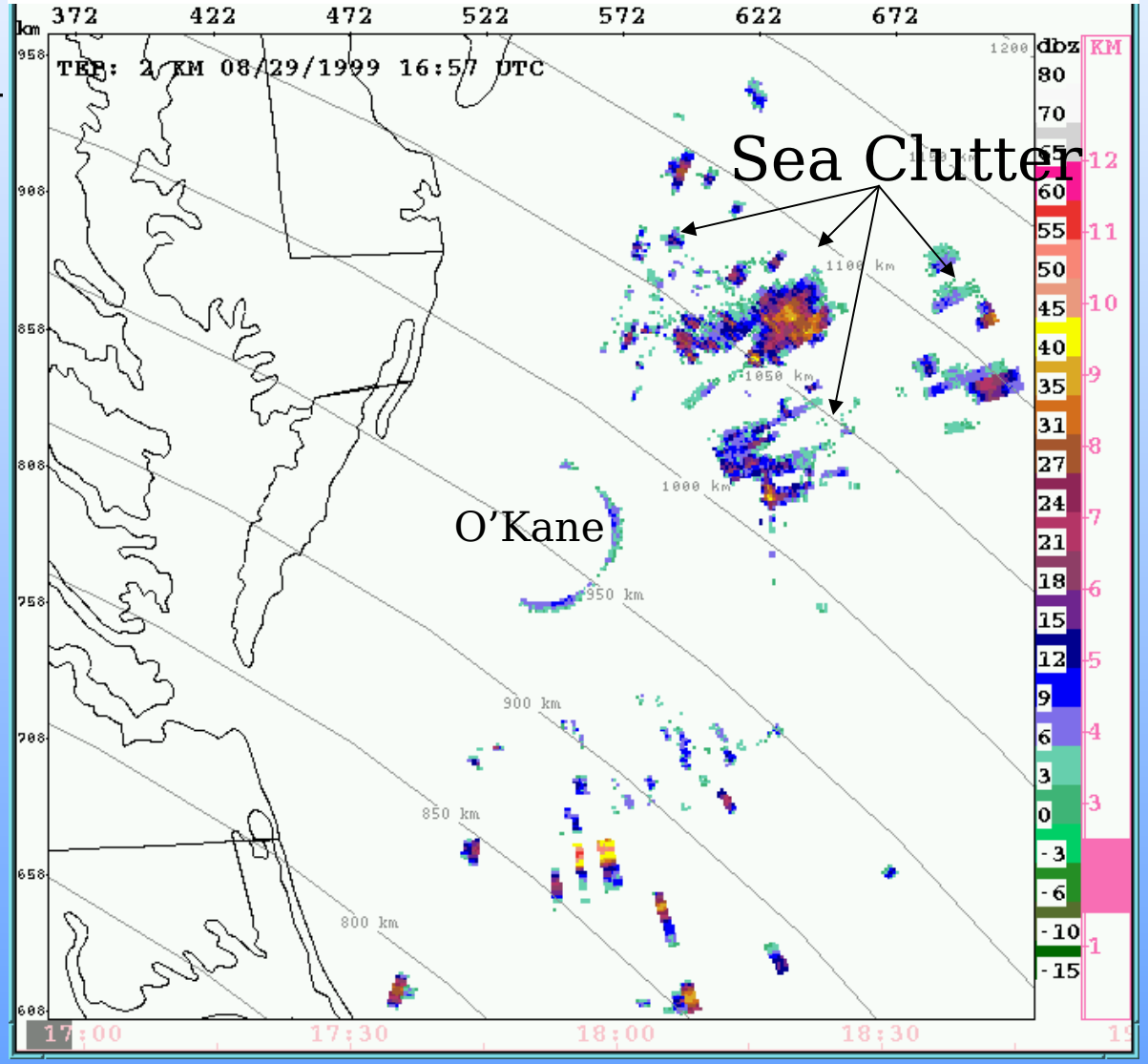


Sea Clutter

Development of a sea clutter detection algorithm is needed for TEP

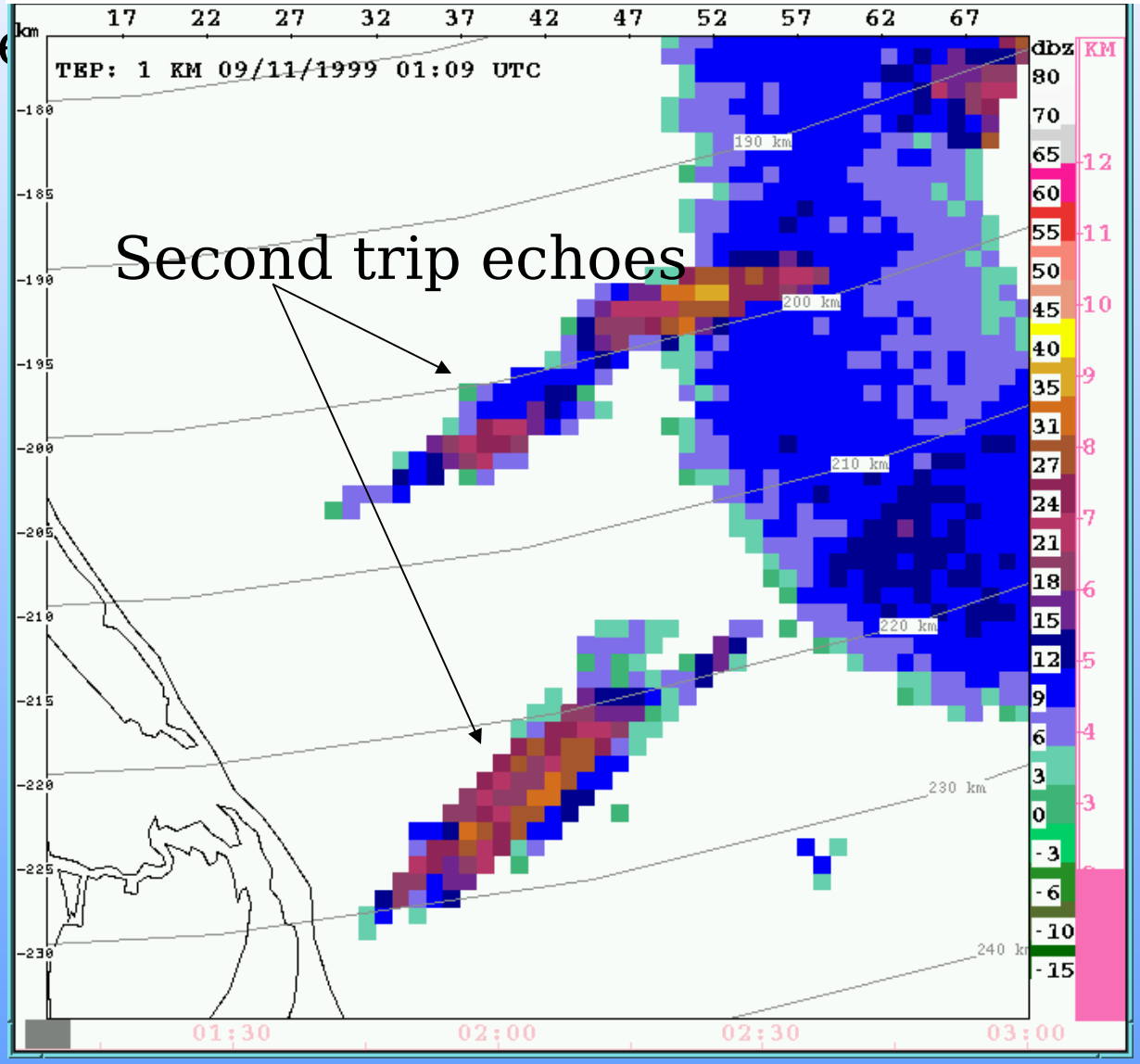
Only 1 TEP case

S-Pol will be at IMPROV and should collect sea clutter data set



Second Trip Echo

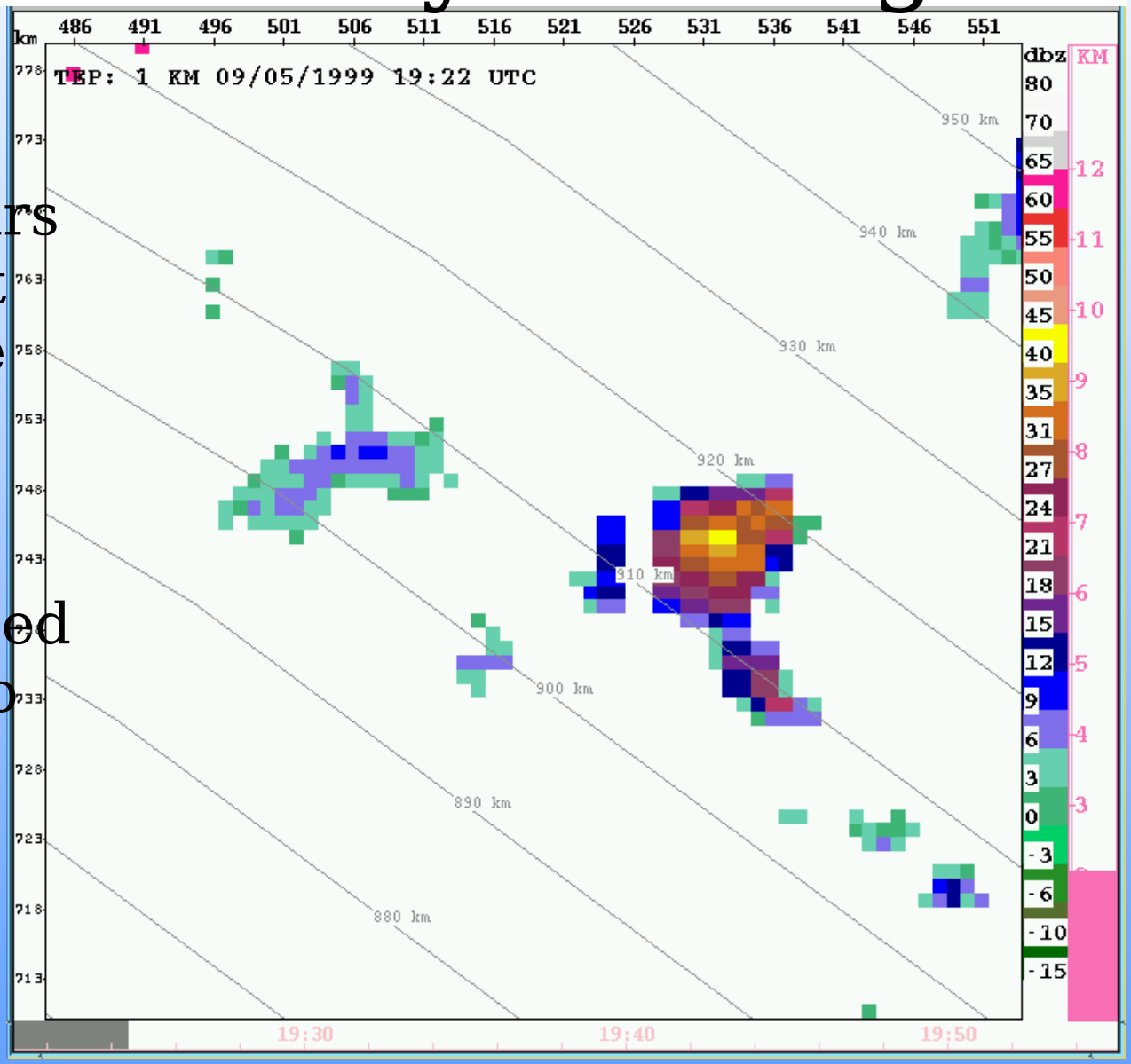
Second trip echoes should be detected and removed from base data



Radial Velocity Aliasing

Unrealistic shears near the nyquist velocity indicate velocity aliasing has occurred

Correction needed before input into algorithms



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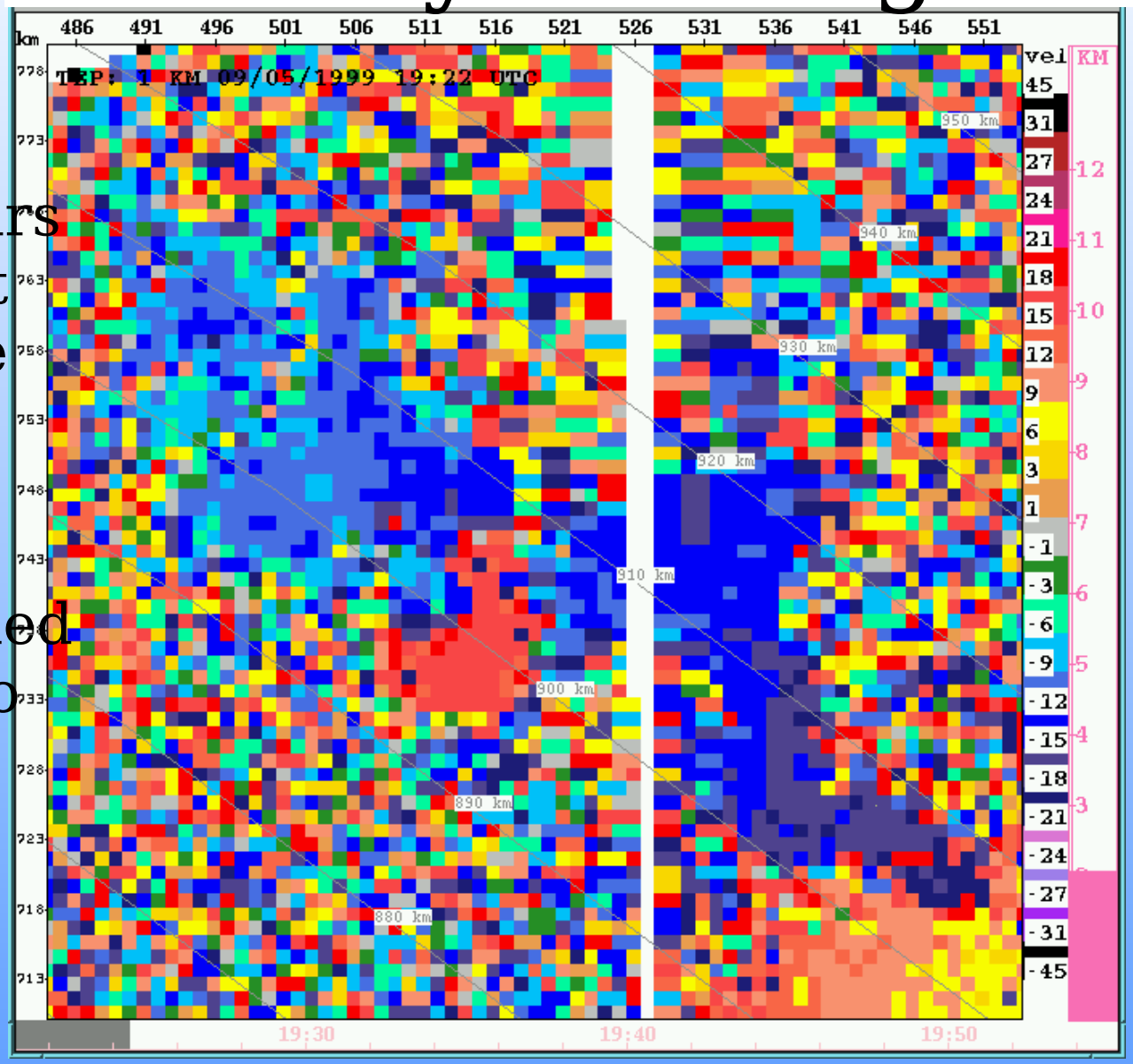
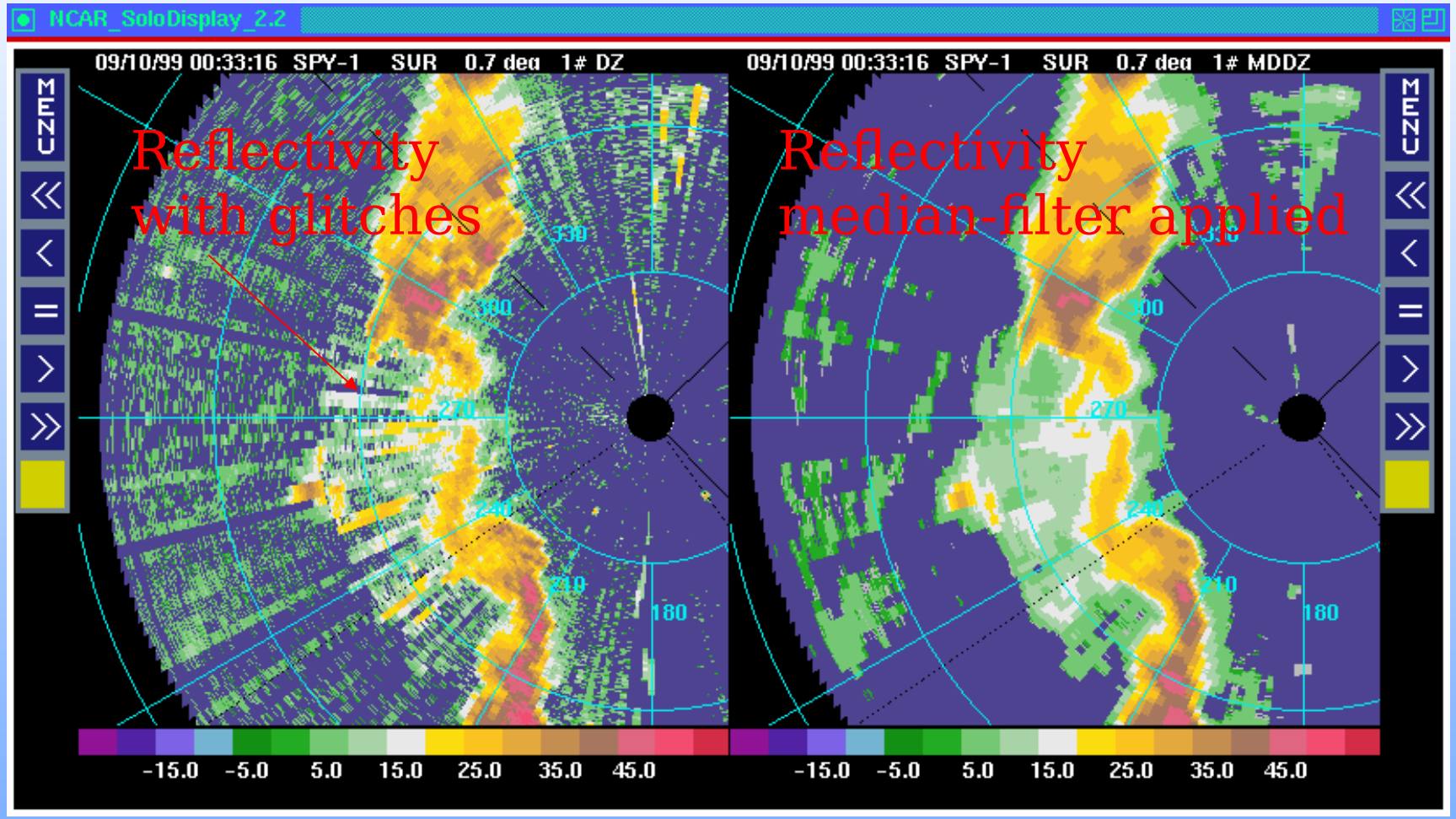


Beam Glitches



Mismatch in elevation?

Filtering improves data quality, but may not be a good

Working in native coordinates may improve data quali

Summary

- Data set very good
  - Includes thin lines, precipitation (extrapolation and dissipation; not sure about initiation)
  - Microburst outflow not yet identified, but haven't been looking for it
    - Normandy May 15, 2000 data set could be useful if radial velocity field can be retrieved
- Next steps
  - Run more radar algorithms
  - Assimilate more data sets

Future Issues

- TEP scanning strategy should be optimized for weather (w/out jeopardizing primary mission of radar)
  - Timely scans
    - 1 minute intervals for microbursts
    - 5 minute intervals for storms
  - Adaptive scanning may be useful

Agenda

Nowcast 6.2 Review

Data Assimilation

1:00 - 1:15 COAMPS-OS/SPAWAR Horizontal Integration — John Cook (NRL)

1:15 - 1:30 ADAS/3D-VAR — Allen Zhao (NRL)

1:30 - 1:45 WxWeb — John McCarthy (NRL)

Data Fusion

1:45 - 2:00 Real-Time Verification — Rosemary Lande (NRL)

2:00 - 2:20 Ceiling and Visibility — Gerry Wiener (NCAR)

2:20 - 2:40 TEP — Cathy Kessinger (NCAR)

2:40 - 2:50 Break

System Architecture

2:50 - 3:05 Overview — John Cook (NRL)

3:05 - 3:25 Tier 1 and Demo — Marie White (Pangaea)

3:25 - 3:40 Tier 2 — Craig Kunitani (Pangaea)

3:40 - 4:00 Tier 3 and Tier 4 — Mike Frost (CSC)

User Interaction

4:00 - 4:10 Buy-In — John McCarthy (NRL)

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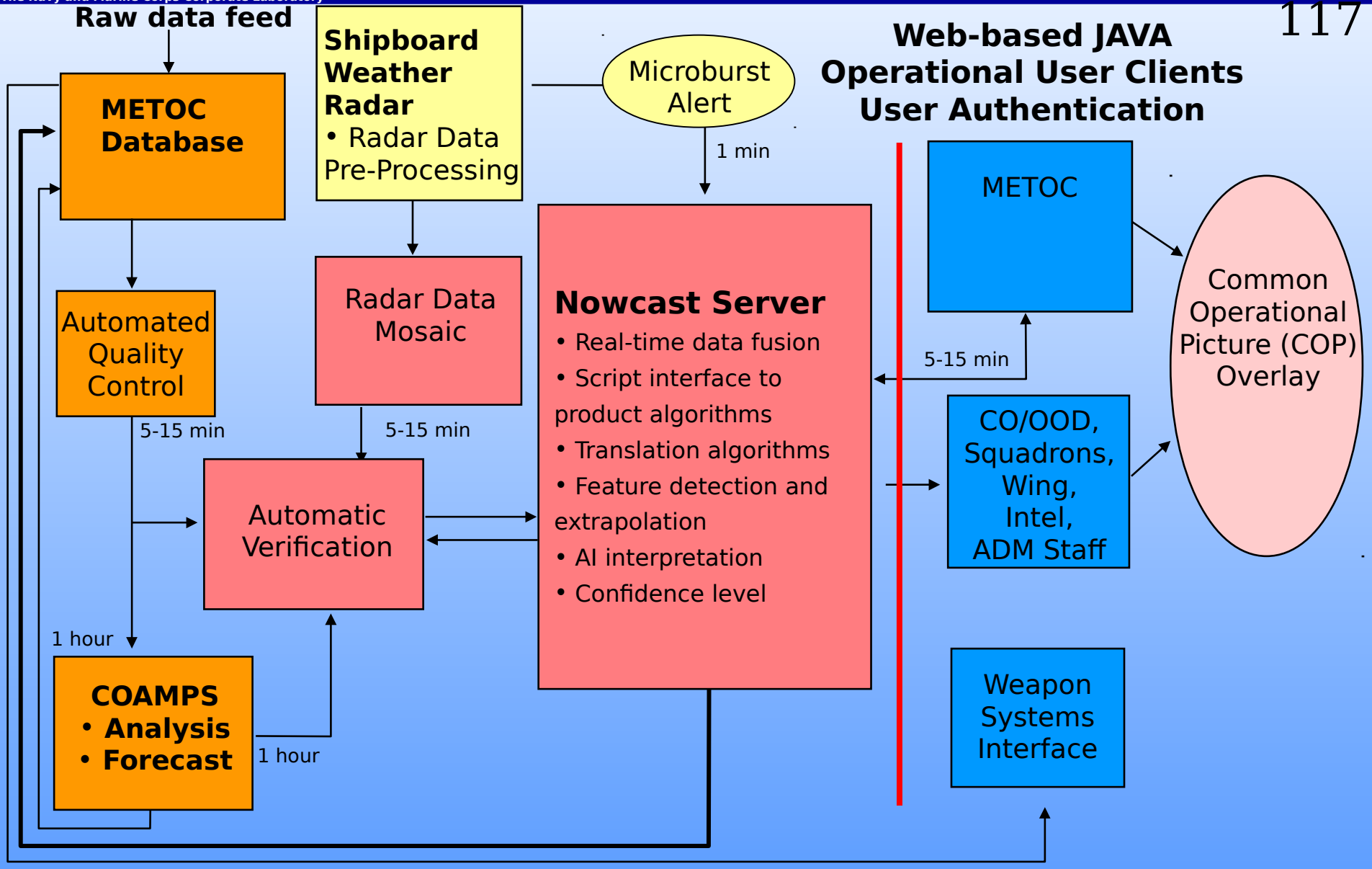
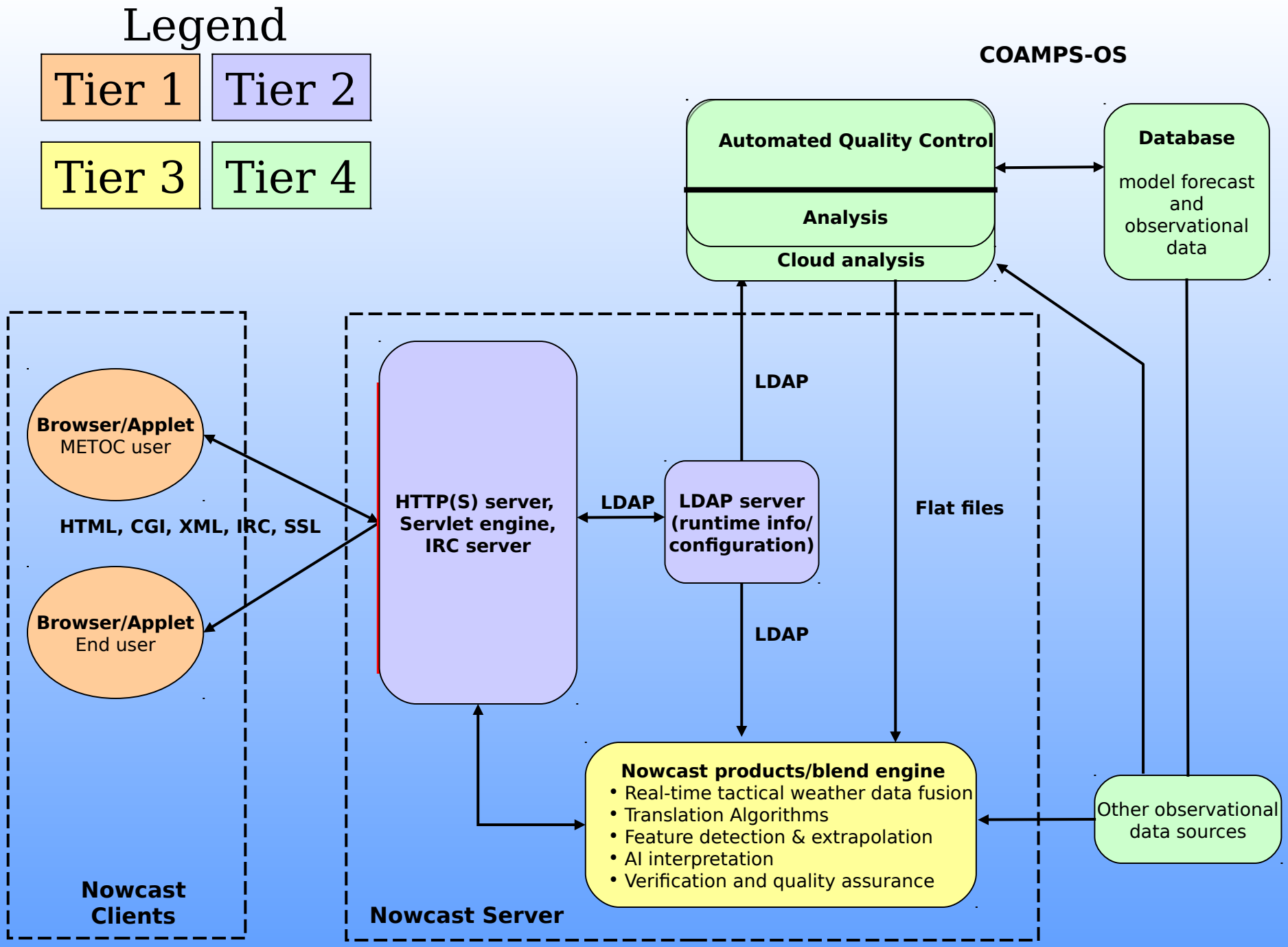
Nowcast Design

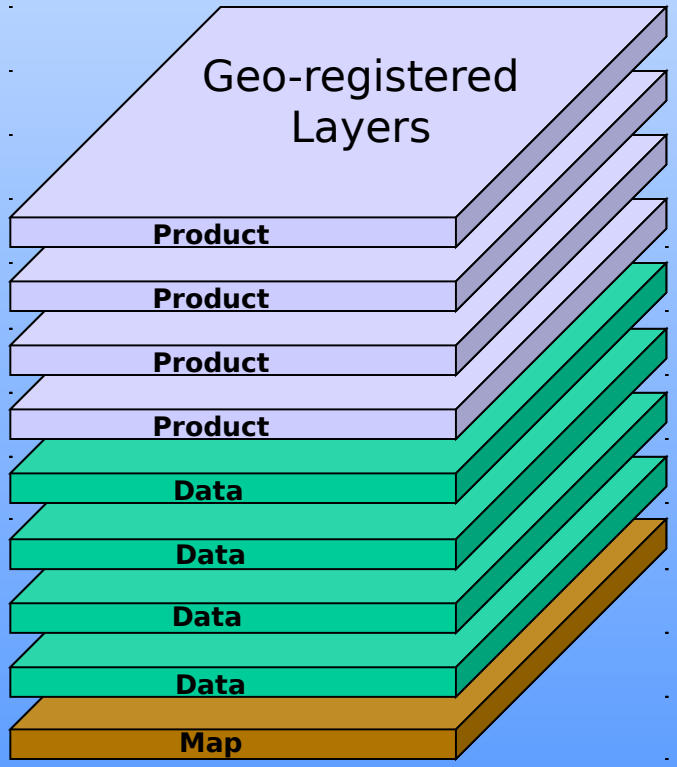



Legend
Tier 1
Tier 2
Tier 3
Tier 4
COAMPS-OS
Automated Quality Control
Analysis
Cloud analysis
Database
model forecast and observational data
LDAP
Browser/Applet
METOC user
HTML, CGI, XML, IRC, SSL
Browser/Applet
End user
HTTP(S) server, Servlet engine, IRC server
LDAP
LDAP server (runtime info/ configuration)
LDAP
Flat files
Nowcast products/blend engine
• Real-time tactical weather data fusion
• Translation Algorithms
• Feature detection & extrapolation
• AI interpretation
• Verification and quality assurance
Other observational data sources
Nowcast Clients
Nowcast Server

Investment in Nowcast

Defining Weather in the Battlespace Environment

- Alert Services/Thresholds
- Multiple Views/Windows
  - Map View
  - Cross Section
  - Time Lines
- History Animation
- Export to the COP
- Product Confidence Level



Organize Into Custom Folders

Warfighter-Specific Folders

Strike Folder
- Winds
- Cloud Tops/Bases
- Visibility
- Icing

TLAM Folder
- Winds/Temps Enroute
- Thunderstorms
- Sea State

Bridge Folder
- Wind Shifts/Seas
- Thunderstorms
- Icing and Turbulence

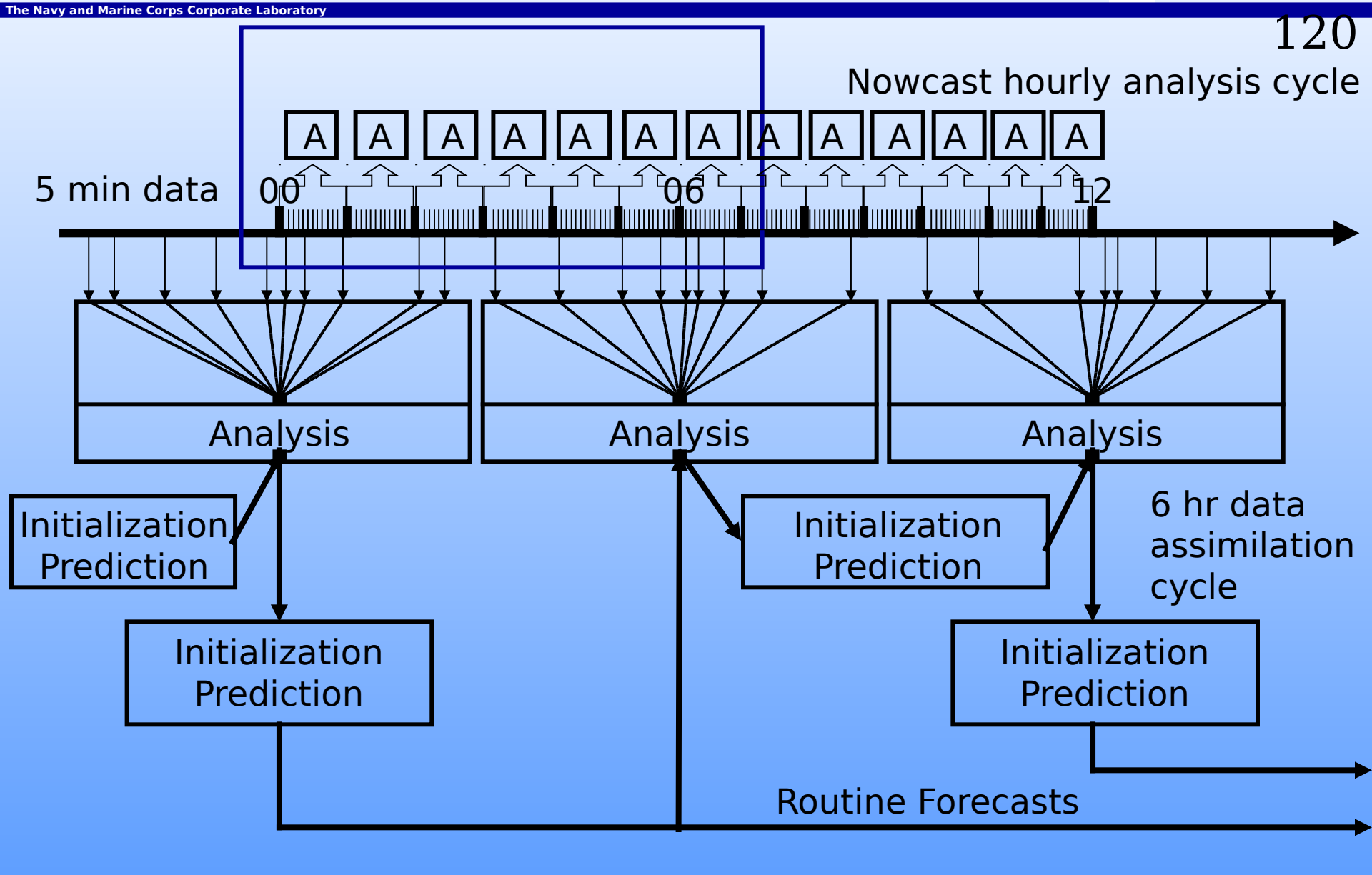
Pilot Folder
- Mission Rehearsal
- 3D Rendering Enroute
- Target Area Weather

CATC Folder
- Ceiling and Visibility
- Thunderstorms

METOC Folder
- Quality Assurance
- Alerts
- User Profiles

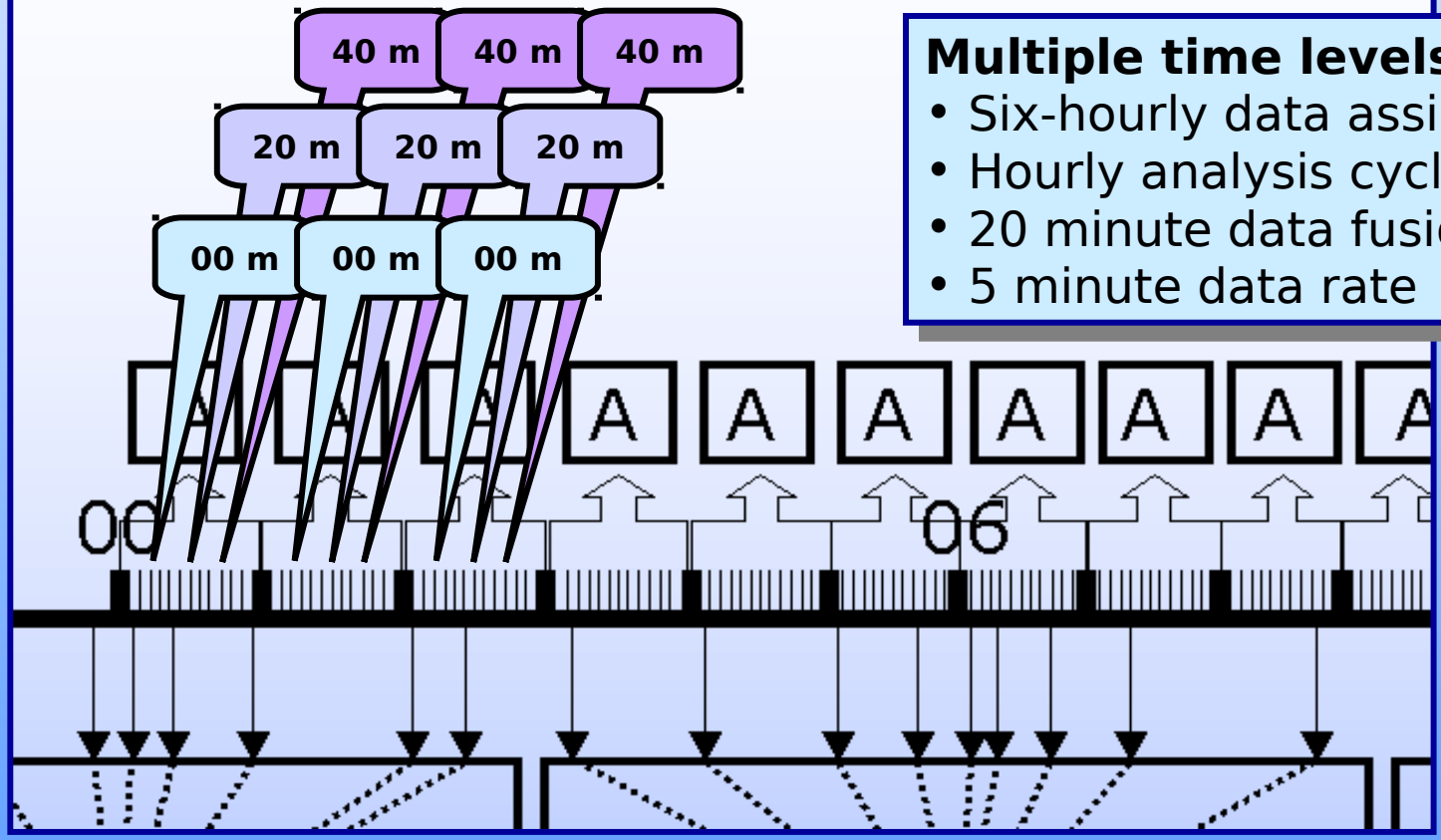
Nowcast Data Fusion Cycle

The Navy and Marine Corps Corporate Laboratory



Nowcast Data Fusion Cycle

- Use hourly analysis as background condition
- Intermediate cycle for AI data fused product generation (approximately every 20 minutes)



Multiple time levels

- Six-hourly data assimilation cycle
- Hourly analysis cycle
- 20 minute data fusion process
- 5 minute data rate

Estimated Nowcast Battlegroup Communications Requirements

Data	Kbits/ sec	Kbits/sec (Compressed)	Data Type	Frequency	Origin
From shore to CV/CVN/AGF/LH					
Conventional	0.083	(75%) 0.021	Alpha text	Continuous	Shore
Satellite	0.356	(50%) 0.178	Binary BUFR	Continuous (30 min)	Shore
Weather Web	0.226	(50%) 0.113	Binary	Continuous	Shore
LBC (45 X 45 deg)	20.62	(50%) 10.31	Binary GRIB	Twice a day (1 hr)	Shore
Total	**21.3**	**10.6**			
CV/CVN/AGF/LH from all ships					
Moriah	0.279	(50%) 0.140	Binary	Continuous (5 min)	All Ships
TEP	56.49	(50%) 28.24	Binary	Continuous (5 min)	AEGIS Ships
Products	214.4	(0.0%) 214.4	Binary images	Continuous (5 min)	CV/CVN/AGF/LH
Total	**271.2**	**242.8**			
Individual ships (customers) except TEP equipped					
Moriah/10	0.028	(50%) 0.014			
Products/10	21.44	(0.0%) 21.44			
Total	**21.5**	**21.5**			
TEP equipped ships					
TEP	56.49	(50%) 28.24			
Moriah/10	0.028	(50%) 0.014			
Products/10	21.44	(0.0%) 21.44			
Total	**78.0**	**49.7**			

Initial Estimates

10.6 kbits/sec (compressed) to large ships twice a day for 1 hour duration

Long-Term Estimates

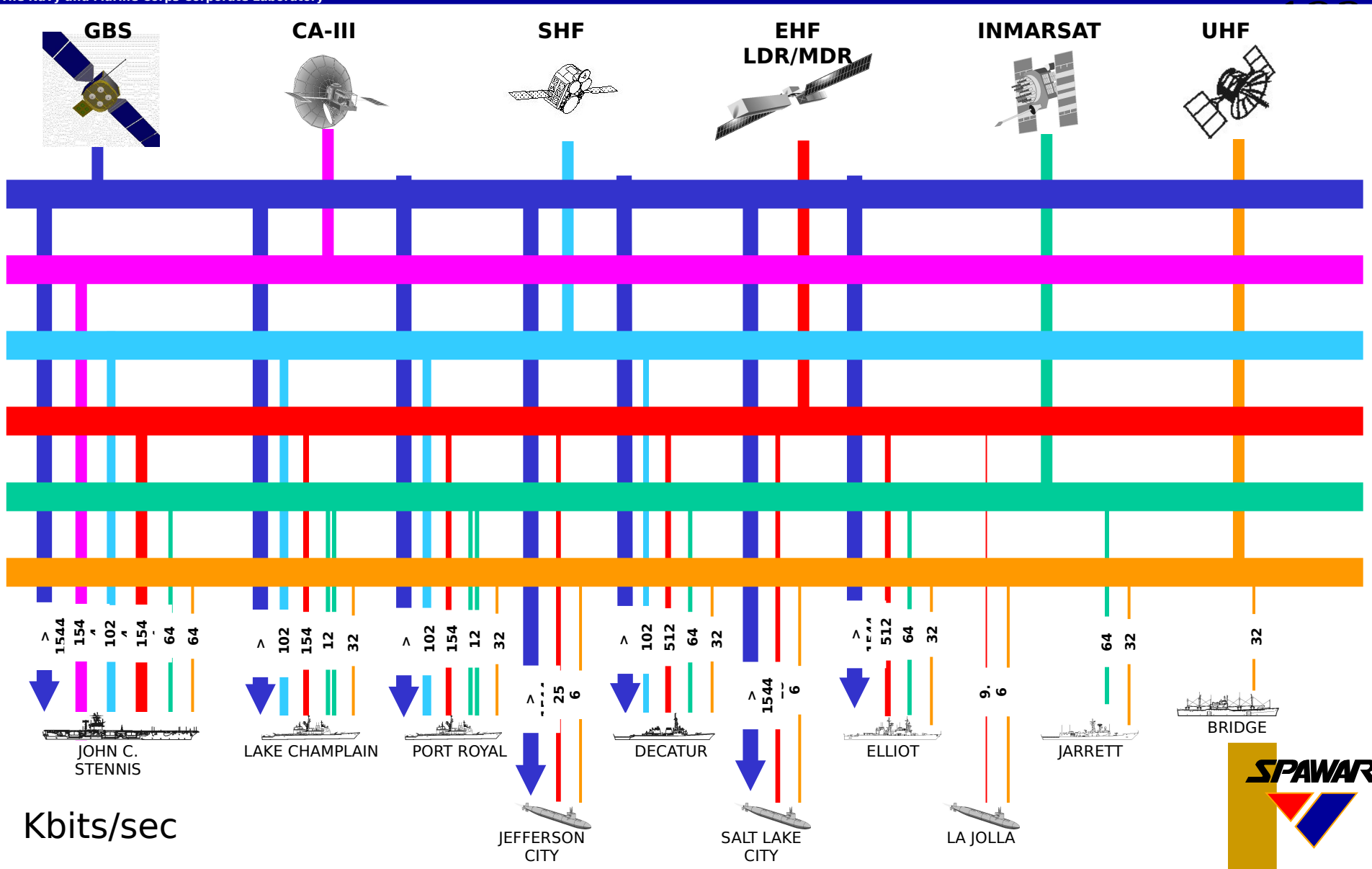
Large ships - 242.8 kbits/sec

Small ship - 21.5 kbits/sec

TEP ships - 49.7 kbits/sec

JOHN C. STENNIS Battlegroup Enhanced Capability (FEB 02)

The Navy and Marine Corps Corporate Laboratory



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Nowcast Tier 1

Tier 1 Development Team

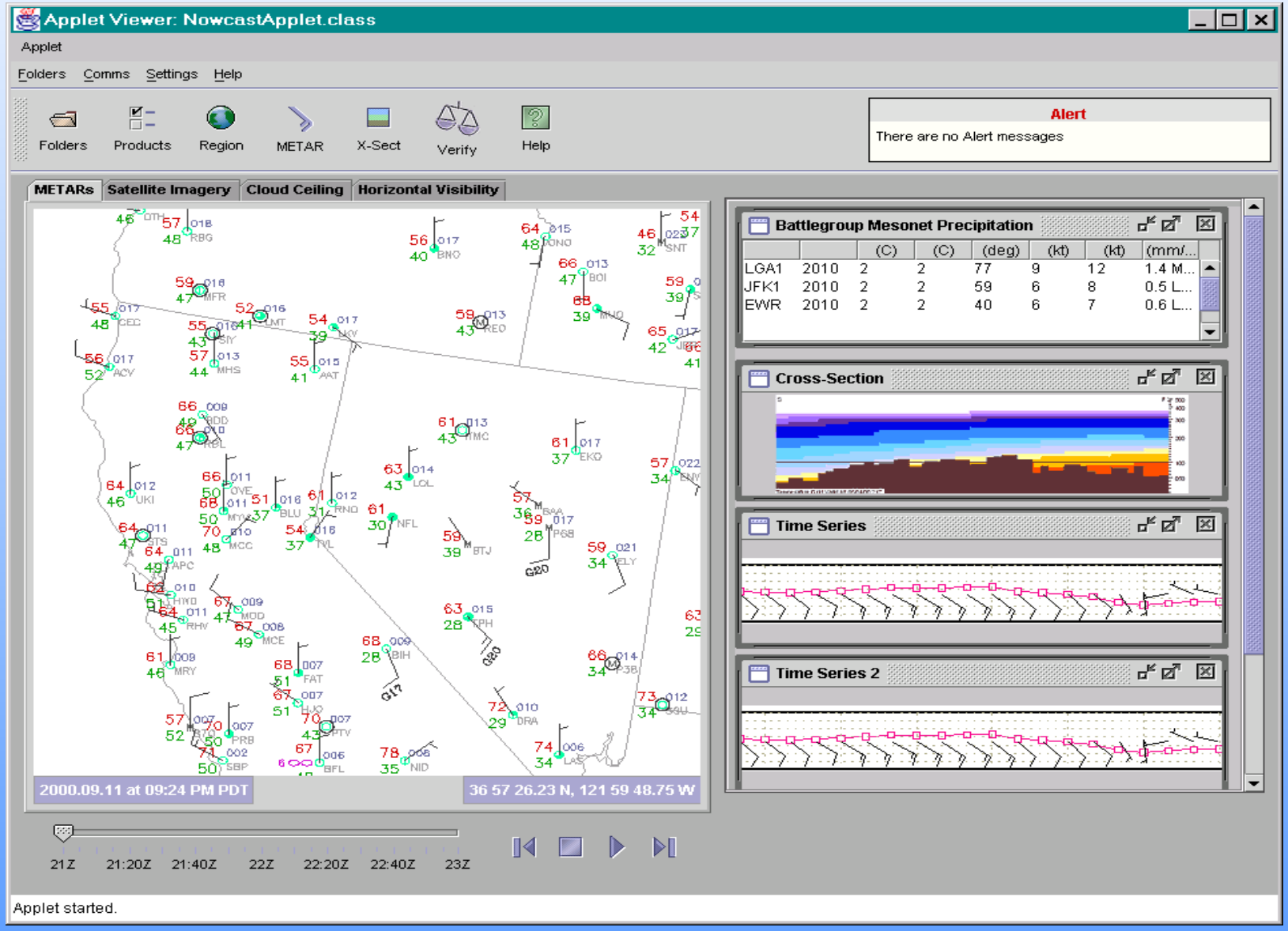
Marie White – Pangaea

Yuehong Liao – Computer Sciences Corp.

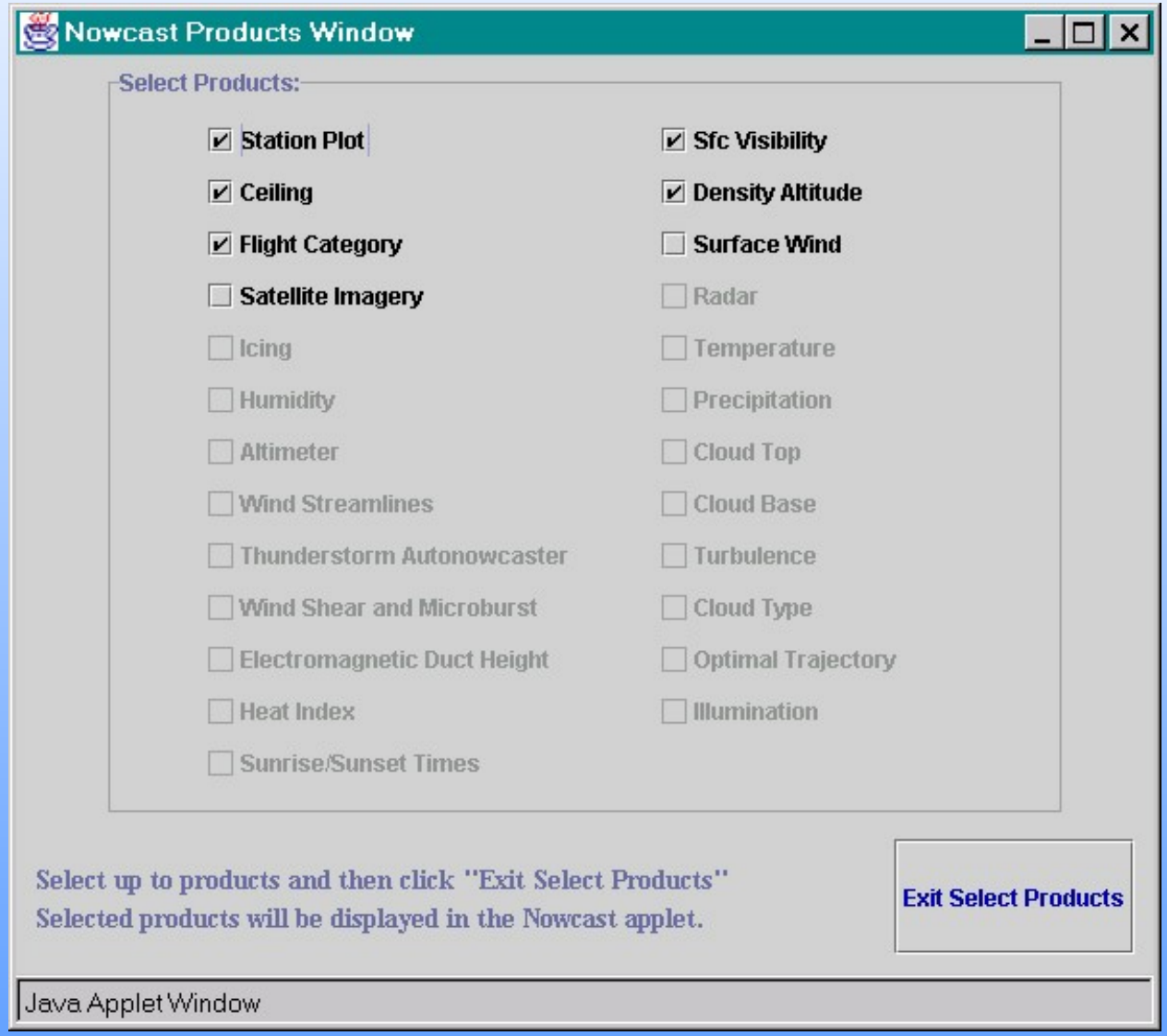
Nowcast Interface

- Provide state-of-the-art technology in an easy to use and intuitive interface
- Customize the interface and capabilities to meet the needs of the warfighters

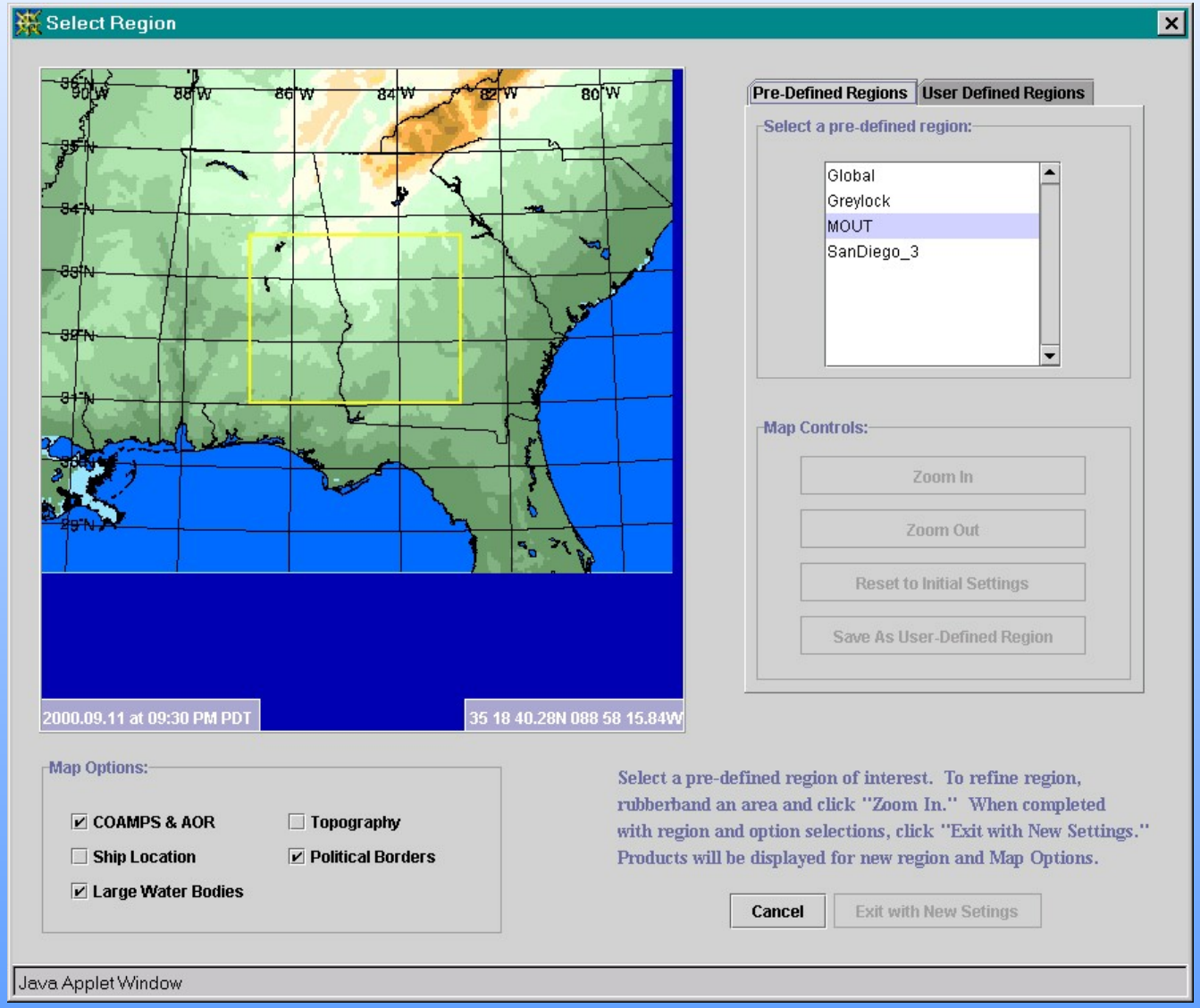
Tier 1 Main Window



Tier 1 Select Products



Tier 1 Select Region



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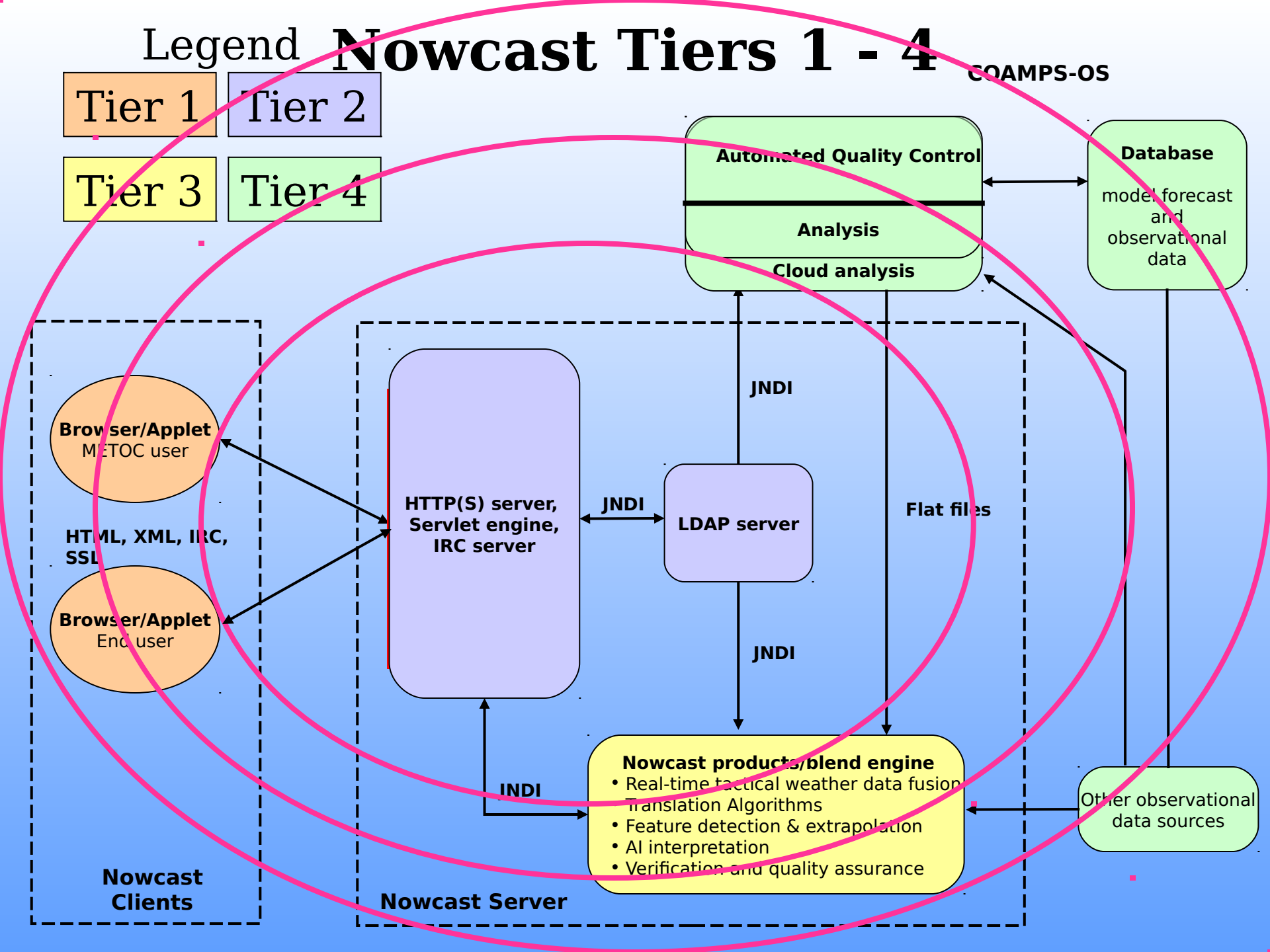
Nowcast Tier 2

Tier 2 Development Team

Craig Kunitani – Pangaea

Ramesh Mantri – SoftSol Resources, Inc.


Legend
Nowcast Tiers 1 - 4
Tier 1
Tier 2
Tier 3
Tier 4
COAMPS-OS
Automated Quality Control
Analysis
Cloud analysis
Database
model forecast and observational data
Browser/Applet
METOC user
HTML, XML, IRC, SSL
Browser/Applet
End user
HTTP(S) server, Servlet engine, IRC server
JNDI
LDAP server
JNDI
JNDI
Flat files
JNDI
Nowcast products/blend engine
• Real-time tactical weather data fusion Translation Algorithms
• Feature detection & extrapolation
• AI interpretation
• Verification and quality assurance
Other observational data sources
Nowcast Clients
Nowcast Server

Tier 2 Design

- Client-Server
- N-tier Architecture
- Modular
- Object Oriented
- Java technologies
- Security
- Ease of deployment & maintenance

Tier 2 Functionality

- Service Tier 1 requests for data & images.
- Provide server side persistent store.
- Authenticate user login.
- Maintain stateful session for user

Tier 2 Communication

- Tier 2 is a middle layer between Tiers 1 and 3.
- Tier 2 services Tier 1 requests.
- Tier 1 & 2 communicate only via port 80.
- Tiers 1 & 2 use HTTP Tunneling.
- Tier 2 is a requestor of Tier 3 on Tier 1's behalf.
- Tier 2 calls Tier 3 ksh scripts.
- Tier 2 reads Tier 3 output from hard disk.

Tier 2 Software

- Third party software
  - Apache Software Foundation HTTP server
  - Caucho Resin servlet server
  - Netscape LDAP server
- Nowcast Tier 2 developed software
  - Java Servlets and package of servlet classes
  - Package of objects shared by Tiers 1 & 2
  - Java applications to load objects into LDAP
  - Java test applications

Third Party Software

- Apache Software Foundation HTTP server
  - Most popular HTTP web server
  - Open source, free
- Caucho's Resin Servlet server
  - A servlet is Java code that executes on the server within the Java virtual machine of a servlet engine.
  - Servlets being used with HTTP server instead of older CGI technology.
  - Open source, $500/deployment server
- Netscape LDAP server
  - Lightweight Directory Access Protocol
  - A TCP/IP network accessible database optimized for reading.
  - Includes system management console application.
  - COTS, DOD wide license with Netscape (http://menk.com/dod_license)

Third Party Software

- Apache HTTP server
  - Serves initial HTML login pages and authentication
  - Serves Applet/Servlet communication via port 80
- Resin Servlet server
  - Serves up all servlets
  - Communicate to Applet through Apache HTTP server
- Netscape LDAP server used to store and serve
  - System constants
  - User profiles (used for authentication)
  - Serialized Java Objects (example: Folders)

Developed Servlets

- loginUser - authenticate user, load applet, return sessionID & initial folderID
- getFolder - given folderID, read folder from LDAP and return folder to applet
- getRegionImage - given EndUserContext, request RegionImage from Tier 3, return to applet
- getMetar - given EUC, process Innovation Vector, return array of Metar data to applet
- getProductImage - given EUC, request ProductImage from Tier 3 and return to applet

Future Development

- Add incremental features
- Add Internet Relay Chat (IRC) capability
- Incorporate Enterprise Java Beans
- Design HTML forms based system management application

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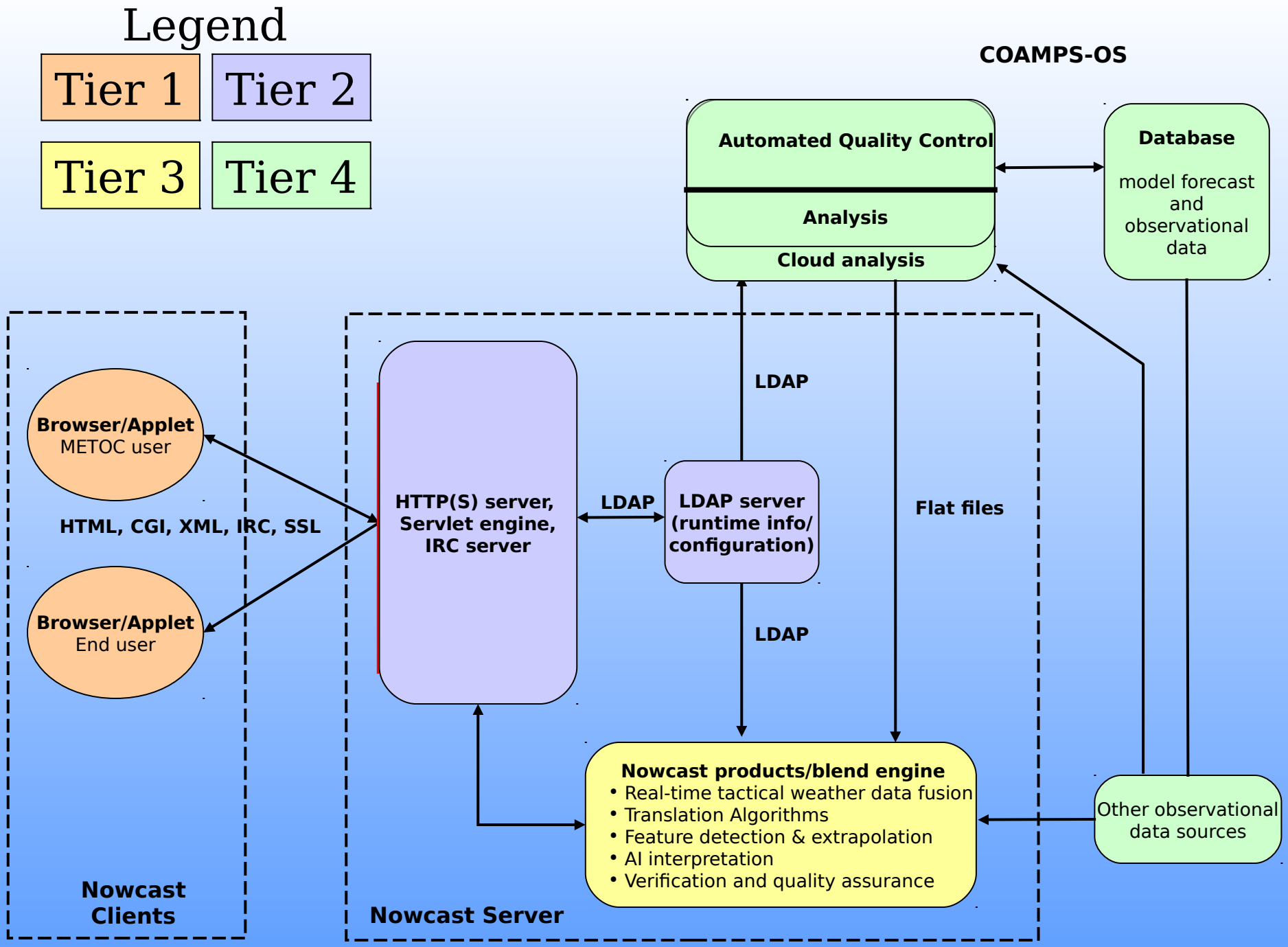
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METOC user
HTML, CGI, XML, IRC, SSL
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HTTP(S) server, Servlet engine, IRC server
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LDAP server (runtime info/ configuration)
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Nowcast Clients
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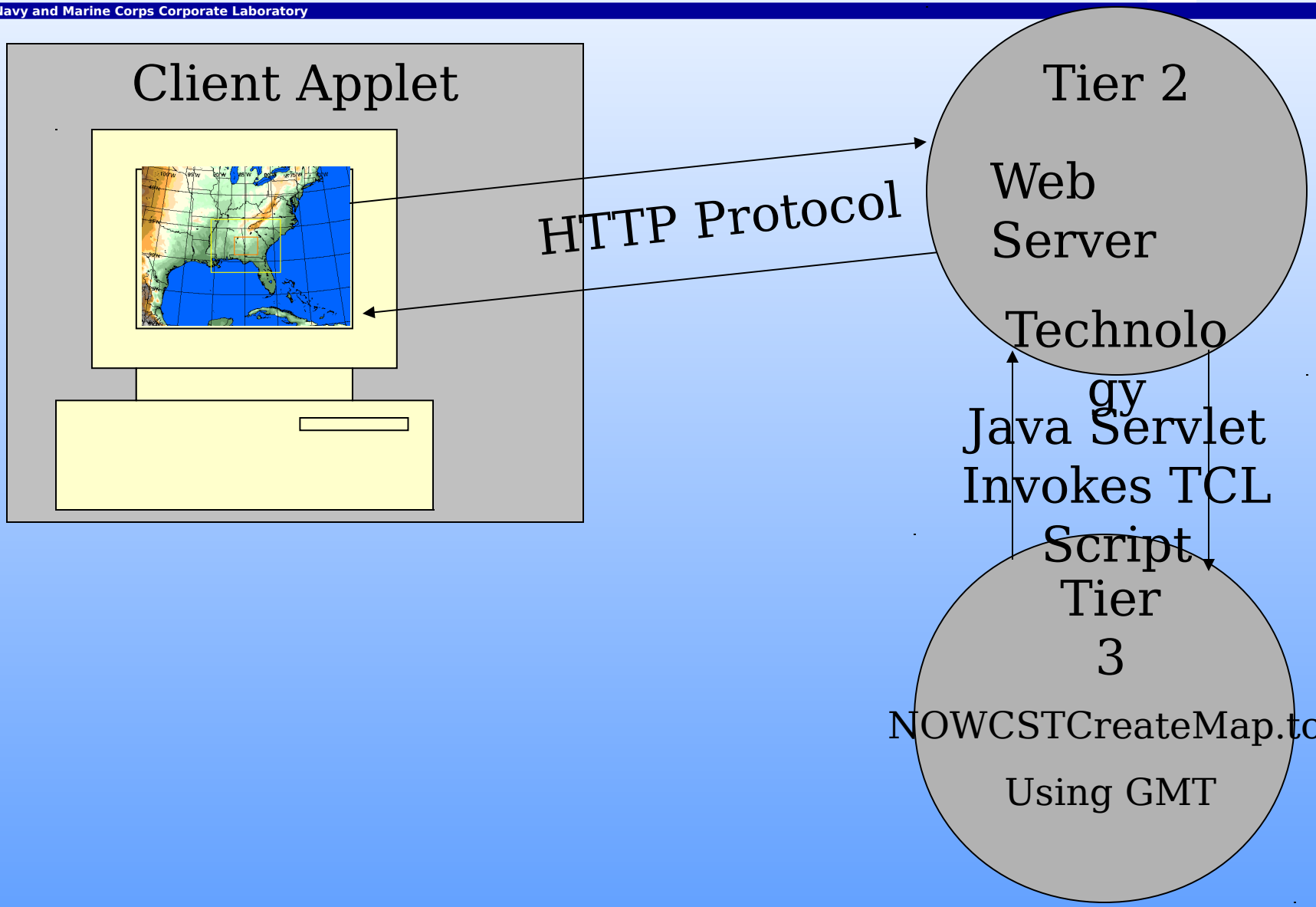
Tier 2 / Tier 3 Interaction

- Processing of Background Maps
  - Script to create Background Maps
- Processing of Product Images
  - Event Notification
  - Script to create Product Images
- Processing of Innovation Vectors
  - Event Notification

Background Maps

- Processing of Background Maps
  - A script, NOWCSTCreateMap.tcl, was developed to create background maps
  - The script utilizes the Generic Mapping Toolkit (GMT) for map rendering
  - The script has many command line arguments for the following optional features:
    - Overlay Topography
    - Overlay lines to represent COAMPS boundaries
    - Overlay Political Boundaries – Future
    - Overlay Rivers / Lakes - Future

Background Maps, Cont



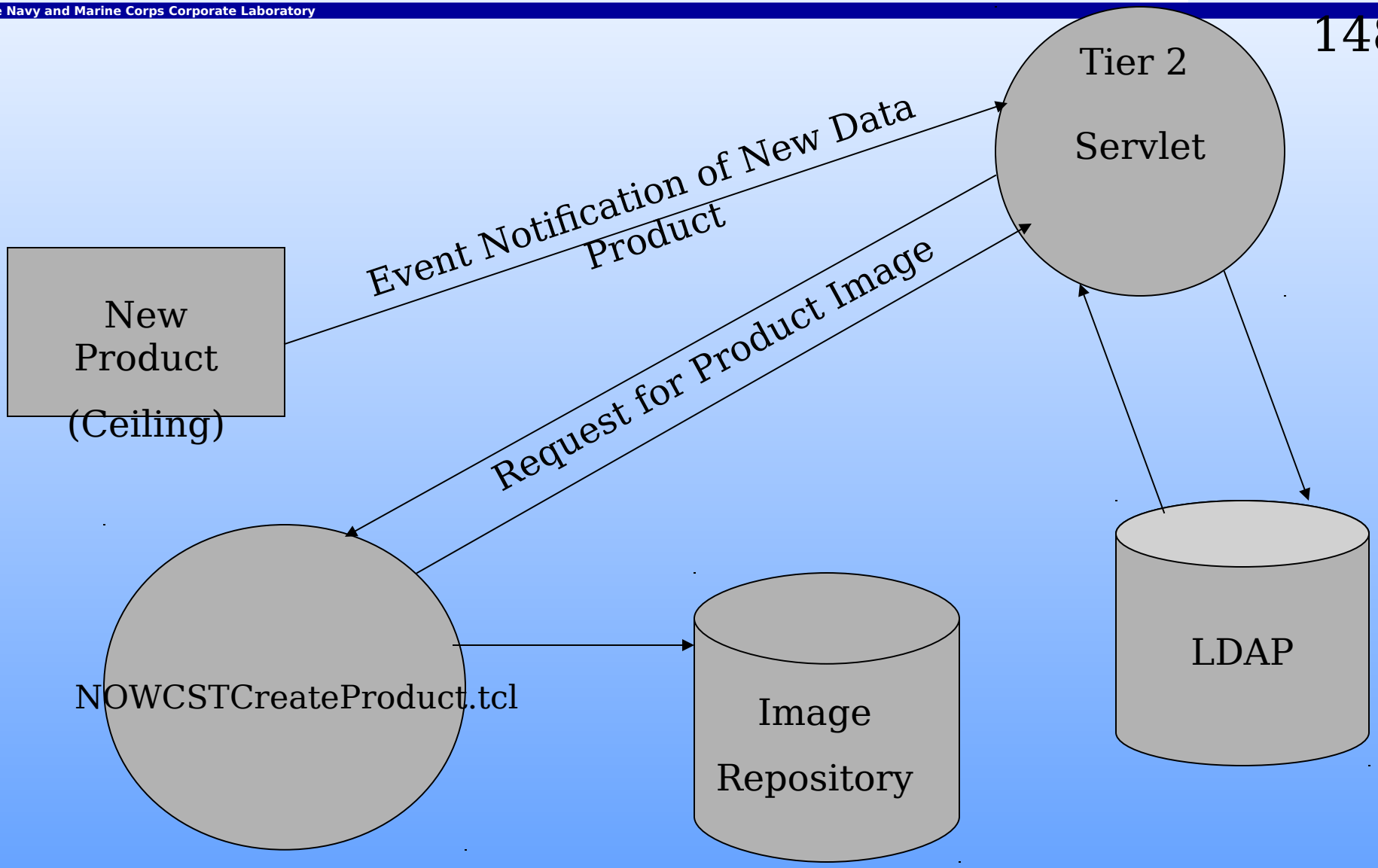
Product Images

- Processing of Product Images
  - Event Notification
    - After a NOWCAST data product is created an Event Notification is sent to Tier 2
    - Tier 2 calls a Script that lives in Tier 3 that creates the actual product images
  - Creation of the Product Images
    - A script, NOWCSTCreateProduct.tcl, was developed to create the product images

Product Images, Cont

- Processing of Product Images
  - Creation of the Product Images
    - Similar to the NOWCSTCreateMap.tcl, this script utilizes the GMT and has many optional features
    - Features additional to the NOWCSTCreateProduct.tcl script are:
      - Custom Color Palette
      - Overlay multiple nests

Product Images, Cont



Innovation Vectors

- Processing of Innovation Vectors
  - Event Notification
    - After a Innovation Vector is created an Event Notification is sent to Tier 2
    - Tier 2 parses the Innovation Vector according to the active sessions

Tier 3

- Processing of Background Maps already discussed
- Creation of Data Products
  - The NCAR C&V will be executed via the UNIX cron table every 15 to 20 minutes
  - This algorithm will utilize the COAMPS data files and the innovation vector
  - The completion of the algorithm will cause the event notification to be sent to Tier 2

Tier 3, Cont

- Creation of Innovation Vectors
  - Innovation Vectors include values from the observations as well as the corresponding interpolated COAMPS value
  - Every 15 to 20 minutes a cron job executes that pulls out the most recently received observations from TEDS
  - These observations are fed into the innov_prep.exe program which produces the Innovation Vector

Tier 4

- COAMPS-OS
  - COAMPS is used in a data assimilation mode
  - The COAMPS forecasts (< 12 hours) are used to feed both the innov_prep.exe and NCAR Algorithms
- TEDS Database
  - Used as a storage repository for the data that is fed into COAMPS-OS

Considerations

- Other Data Sources
  - Other sources of data will be used in the future
    - UAV
    - Classified Observations
    - Satellite Data
    - Weather Web
  - It is possible that data sources will be asynchronous and by-pass TEDS

Considerations, cont

- Usage of the Generic Mapping Toolkit
  - The usage of GMT in NOWCAST is contained within very few scripts
  - Specifically, GMT is used to render the geography and to overlay the environmental data (contours)
  - GMT could replaced with another mapping toolkit that provides similar functionality
    - Handles all COAMPS projections
    - Can be executed in a ‘batch’ mode

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NRL Seeks Support for Nowcast

- **Expression of operational need for Nowcast including financial resources to tailor Nowcast to operator's needs**
  - **Need user buy-in to support Nowcast program**
- **Support from operators for use of SPY-1 radar data for Nowcast battlespace environment picture**
- **Assistance in continuing the Integrated Product Team with NRL, METOC, warfighters, and data providers**

Nowcast Background

- **Dr. McCarthy orientation cruise aboard CVN-72 (March 1998)**
- **Endorsement from CCDG-3 (April 1999)**
- **Endorsement from NSAWC (September 1999)**
- **R&D program started (October 1999)**
- **Endorsement from Third Fleet (March 2000)**
- **IPT meeting (July 2000)**
- **Briefing to COMAEWWINGPAC/N31, VAW-113, and NAWC-WD Pt. Mugu (August 2000)**
- **CAG WARCOM briefing (August 2000)**

Nowcast Funding Plan

The Navy and Marine Corps Corporate Laboratory

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R&D

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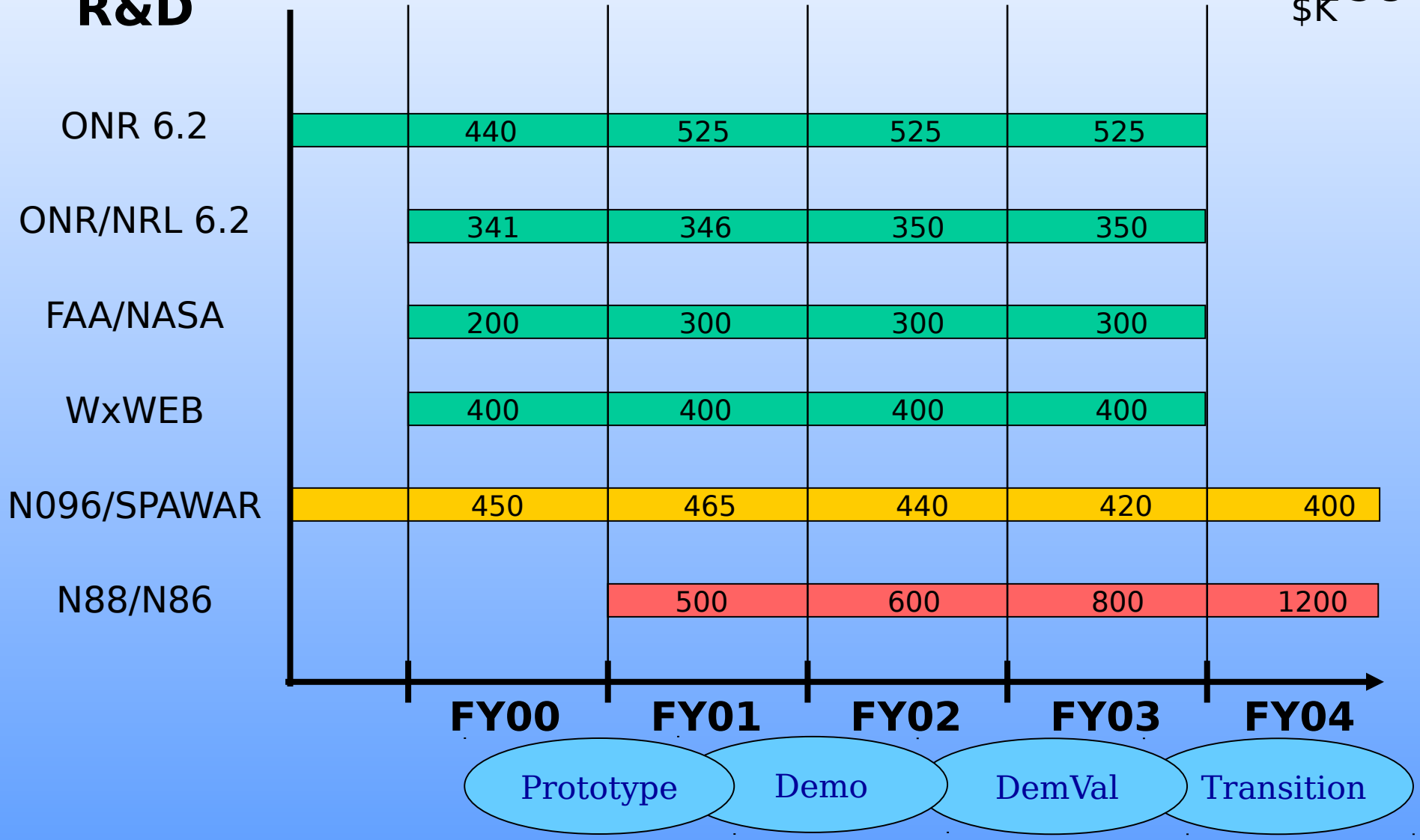

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Integrated Product Team

- To foster a NOWCAST effort that best matches science and technology with the needs of the warfighter

- Ensure the products developed meet the following criteria:
  - Useful to the warfighters
  - Are addressable to Navy requirements
  - Have a strong scientific and technology base
  - Integrated with METOC systems
  - Clear transition path to the Fleet

- The IPT proposed to meet twice a year, likely at NRL, Monterey

- Separate follow-up mechanism for direct individual feedback

Specific Objectives of IPT

- Describe potential products for various phases of the battlegroup and battlespace environment

- Gain feedback on the value of such products for the operational end-user (warfighter and related support personnel/functions); **AN ON-GOING PROCESS**

- Entertain a process whereby NOWCAST scientists and engineers work continuously to insure the value of the system

- Work with the METOC community to ensure that **QUALITY ASSURANCE** is maintained and that there is an integrated relationship between NOWCAST and the non-automated functions of METOC at sea

Specific Questions to be Addressed

- How do the warfighters expect to use NOWCAST products in terms of frequency, duration, location, and for what purposes? Hands-on?
- Are there important capabilities that they would like to see that we are not currently planned for NOWCAST?
- Are warfighter users accepting of the automated approach of NOWCAST?
- Is the METOC community of a like mind in terms of automation?
- How long should the time history of the products be maintained? We are planning one hour at this time.
- What do warfighters think of handheld (e.g., PALM) wireless or voice delivery?
- How important do users feel about including web-based training in NOWCAST?
- **BOTTOM LINE:** We are going to show you products that we think you may like, and want to work with you to bring them to use in the Carrier Battlegroup; we need your feedback.

IPT Attendees Representing the Fle

Barkley, Dr. John, NSAP, COMSUBPAC
Bohnstedt, CDR Kevin, NAS Lemoore
Bostrom, Mr. Greg, SPAWAR SC, D841 (Communications)
Domino, LT Anthony, NSAWC
Freitas, LCDR Ron, AIRPAC CNAP N32 (Air Traffic Control)
Kalbfleisch, FCC(SW) Kurt, Fleet Combat Training Center Pacific (FCTCPAC) McDonald, CAPT Harvey, AIRPAC
McDonnell, Mr. John, SPAWAR SC (REDS Project)
Wilson, LT Stan, COMSTRKFIGHTWINGPAC, NAS Lemoore

Bacon, CAPT Jeff, XO, FNMOC
Bosse, CAPT Tom, CO, NLMOC
Curry, Mr. Kim, NPMOC San Diego
Hagaman, CDR Bruce, THIRD FLEET
Lawson, CAPT Rob, CO, NPMOC San Diego
Little, Mr. Bill, NPMOC Pearl Harbor
McKeown, Dr. Walt, NLMOC
Meanor, Mr. Denis, N961
Pind, CAPT Mike, CNMOC
Spinelli, LCDR Julia, Director, NAVO PAC COMP
Swaykos, CAPT Joe, CO, FNMOC
Waring, LCDR Pat, NAVAIR
Wos, CDR Ken, NSAWC

Nowcast IPT Agenda
Wednesday, 19 July 2000

The Navy and Marine Corps Corporate Laboratory

0730 – 0800	Refreshments	
0800 – 0815	Introduction	Dr. Merilees
0815 – 0830	Objectives of IPT	Dr. McCarthy
0830 – 0930	Status of Nowcast	Dr. McCarthy and Mr.
0930 – 1000	Discussion	LCDR Freitas (AIRPAC ATC)
1000 – 1015	Break	
1015 – 1115	Products supporting CVN air ops	Dr. McCarthy
1115 – 1200	Discussion	CAPT McDonald (AIRPAC)
1200 – 1300	Lunch	
1300 – 1330	Products supporting STW	Mr. Cook
1330 – 1400	Discussion	CDR Bohnstedt and LT Wilson (NAS Lemoore)
1400 – 1430	Products supporting TLAM	Mr. Cook
1430 – 1445	Discussion	FCC(SW) Kalbfleisch (FCTCPA
1445 – 1500	Nowcast User Interface	Dr. White
1500 – 1515	Break	
1515 – 1530	METOC Quality Assurance	Mr. Cook
1530 – 1545	Discussion	CAPT Lawson (NPMOC)
1545 – 1700	General Discussion	Dr. McCarthy
1730 – 1900	Marshall Stack	McCarthy and Shawver reside

Nowcast IPT Agenda
Thursday, 20 July 2000

The Navy and Marine Corps Corporate Laboratory

0730 – 0800	Refreshments	
0800 – 1000	User Reactions	CAPT Bosse (NLMOC)
	CAG	CAPT McDonald (AIRPAC)
	STW Aviation	CDR Bohnstedt, LT Wilson
(NAS		Lemoore) and LT Domino
(NSAWC)		
	STW Weather	CDR Wos (NSAWC)
	ATC/Ops Officer	LCDR Freitas (AIRPAC ATC)
	TLAM	FCC(SW) Kalbfleisch
(FCTCPAC)		
	USMC	
	Communications	Mr. Bostrum
(SPAWAR)		
1000 – 1015	Break	
1015 – 1130	METOC Reactions	CAPT Pind (CNMOC)
	CNMOC	CAPT Pind
	NLMOC	CAPT Bosse
	NPMOC San Diego	CAPT Lawson
	NPMOC Peral Harbor	Mr. Little
	NLMOC	Dr. McKeown
	THIRD FLEET	CDR Hagaman

IPT Summary

A lively and honest exchange of information, requirements and concerns attended by warfighters, engineers, scientists, managers, and METOC

1. Requirements for STW
   - "Now" characterization of the battlespace weather does not currently exist
   - Priorities are data fusion in target areas, enroute, and launch/recovery areas
   - Supplement existing systems with an automated, continuously updated capability
   - Needs vary – organization of products into folders is a must
   - Develop 3D products for specific use
   - METOC provides quality assurance
   - Interoperate with Link 16, Top Scene, PFPS, JMPS
   - Keep the display simple and show the customer a picture

2. Requirements for OA Division
   - Provides support to help integrate diverse information
   - Quality products are #1 concern; need to develop CONOPS for quality

IPT Summary

3. Programmatic Approaches
   - Do not over sell – include caveats on the dependence of sensor data not yet available
   - Prioritize the product list and select a few first products and deliver them well
   - Address issues of forecaster injecting or manipulating information and potential for contradictory products
   - Develop CONOPS for accessing data from non-traditional and classified sources
   - Continue to explore new methods to handle the growing volume of data
   - Obtain feedback from AIRLANT, SURFPAC and other potential customers (AAW, Amphib, EA-6B, E-2, etc.)

4. Specific Product Comments
   - 16 product questionnaires returned and need to be compiled
     - Maintain a set of default folders with METOC ability to help users manage folders
     - Not much enthusiasm for chat capability to confer with METOC
     - Need GIS map backgrounds
     - Get products where they are needed (bridge, CATC, link 16, TWCS, etc.)

5. Critical Issues

Nowcast Definition

- **"Now" weather directly to the warfighter**
  - **0 to 2 hour timeframe, continuously updated, data fusion system**
- **Automatically integrates weather data over areas of interest**
  - **Target areas, enroute, and launch and recovery**
- **Maintained and quality certified by the METOC office**
  - **Extension to the forecast services currently provided**
- **Web-based; network-centric architecture**
  - **IT-21 compliant**
  - **Standard navy hardware**

Review Slide from Nowcast IPT (19 - 20 July 2000), NRL Monterey

Warfighter (TACAIR)

"**Requirement**" Bombs on Target

Efficiency
Limited Resources

Intel

Weather

METOC

Current State

Time frame	scale	capability
Long Range (5+days)	SYNOP	Good
Short /ATO (2-3 days)	MESO	Developing
"Showtime" (1-2 hrs)	MICRO	Limited

CVBG Environmental Battlespace Characterization

3-D Vis

- Hazard Wx depic
- Cloud depiction
- C & V
- Precip
- Hi res wnds
- Divert field info
- Turbulence
- Icing
- Temp
- Humid
- EM/EO

TEP

MORIAH

SMAP / KIS

Enroute Weather

- Flight level wnds
- Cloud layers
- Turbulence
- Icing
- Contrails
- T- Storms tops

SMAP / KIS

Target Area Environmental Characterization

3-D Vis

- FLIR Detec & LO rg
- IRTSS image
- Laser Desig ranges
- Hazard Wx depictio
- Cloud depiction
- C & V
- Temp
- Humid
- Thermal Crossove
- EM/EO

Wx Web

UAV ?

Black Sats ?

SMAP / KIS

METOC CONCERNS

- Nowcast vs Forecast
- CONOPS
- Manpower
- Training
- Complexity
- Quality Assurance
- Expanded exposure (Fleet buy-in)
- System Interoperabili

(Show me a picture / Keep it simple)

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Radar Data for the METOC

- Radar in the METOC community today
- Research plan for Radar Data at NRL Monterey

Radar Data for the METOC

- TEP
- Supplemental Weather Radar
- NEXRAD

Supplemental Weather Radar

- C-Band 5.3-5.7 GHz Doppler scanning radar
- Beamwidth 2.25 degrees, 0 to 90 degrees elevation
- Max effective range (for intensity, radial velocity, and spectral width) is about 120km
- Enterprise Electronics Co.

Supplemental Weather Radar

- Installed already at 7 METOC sites:
  - Naval Unit, Keesler AFB, MS
  - NAS Fallon, NV
  - NAS Keflavik, Iceland
  - NAVSTA, Guantanamo, Cuba
  - NAVSUPPFAC Diego Garcia
  - NAVSTA Rota, Spain
  - NAVSUPPACT Souda Bay, Crete
- 4 (or 5) have been purchased (SPAWAR 185):
  - MCAS Iwakuni, Japan
  - NAS Sigonella, Sicily
  - NPMOC Yokosuka, Japan
  - NRAD Point Loma, CA

NEXRAD

- S-Band 2.7-3.0 GHz Doppler scanning radar
- Beamwidth 0.93 degree, -1 to 45 degrees elevation (normal 0.5 to 19.5 degrees)
- Max effective range (for intensity, radial velocity, and spectral width) is about 230km
- 160 sites including 22 DOD sites

NEXRAD at NWS Monterey

RDA

Base Data
(Level 2)

RPG

NWS
(1/1/2001)

NIDS

Products
(Level 3)

PUP

Navy has
33 units.

Radar Data for the METOC

In a few years . . .

- TEP (~ 20)
- Supplemental Weather Radar (~20)
- NEXRAD (~40)

Different Radar Data and Products will be available for NOWCAST

Radar Data at NRL Monterey

- Data Assimilation
- NOWCAST (Data Analysis)
  - Reflectivity (ADAS type approach)
  - Winds (Data Analysis)
- Graphics Presentation

Radar Data at NRL Monterey

- Data Sources (TEP, NEXRAD, SWR)
- Data Processing Unit
  - I&Q Data
  - Level 2 Data
  - Products
- Staff (Recruiting)
- Security Issues

Agenda

Nowcast 6.2 Review

Data Assimilation

1:00 - 1:15	COAMPS-OS/SPAWAR Horizontal Integration	John Cook (NRL)
1:15 - 1:30	ADAS/3D-VAR	Allen Zhao (NRL)
1:30 - 1:45	WxWeb	John McCarthy (NRL)

Data Fusion

1:45 - 2:00	Real-Time Verification	Rosemary Lande (NRL)
2:00 - 2:20	Ceiling and Visibility	Gerry Wiener (NCAR)
2:20 - 2:40	TEP	Cathy Kessinger (NCAR)
2:40 - 2:50	Break	

System Architecture

2:50 - 3:05	Overview	John Cook (NRL)
3:05 - 3:25	Tier 1 and Demo	Marie White (Pangaea)
3:25 - 3:40	Tier 2	Craig Kunitani (Pangaea)
3:40 - 4:00	Tier 3 and Tier 4	Mike Frost (CSC)

User Interaction

4:00 - 4:10	Buy-In	John McCarthy (NRL)
4:10 - 4:30	IPT	John McCarthy (NRL)

What Nowcast Has Today

- **DAMPS deployed at regional centers; shipboard transition of COAMPS-OS to SPAWAR in progress**
- **High-level architecture designed, documented and web-based client/server prototype under construction**
- **Ceiling and Visibility Nowcast product will be the first product to emerge from the AI data fusion engine (tri-agency program)**
- **Connectivity to DUSD (S&T) Smart SensorWeb effort for sensing and disseminating target area weather data (WeatherWeb)**
- **Development of automated verification and quality assurance capability**
- **Development of tailored end-user products in coordination with IPT**
- **Documented baseline communications requirements for N096 and SPAWAR**

Planned Nowcast Products

❶ Horizontal Visibility, Cloud Ceiling, and Flight Category
❶ Temperature, Humidity, Precipitation, and Heat Index
❶ Low-Level Winds
❶ Density Altitude and Altimeter Setting

❷ Cloud Location, Top, Bottom, and Fraction
❷ Thunderstorm Autonowcaster
❷ Three-Dimensional Depiction of Hazardous Airspace
❷ Electromagnetic Duct Height and Modified Refractivity Profiles
❷ Weather Web Data for Denied Areas

❸ Wind Shear and Microburst
❸ Extent of In-Flight Icing
❸ Extent of In-Flight Turbulence
❸ Satellite and SPY-1 (TEP) Radar Feature and Hazard

6.2-Nowcast (ONR)

FY00 Milestones:

1. Develop a Prototype Nowcast Client/Server System
   - Documented high level design and communications estimates
   - Four-tier internet architecture
   - Leveraged Weather Web effort

2. End-User Interaction (IPT)
   - July 19 – 20, 2000

3. End-User Product Development
   - NCAR C&V product (leveraged C&V effort)
     - Coordinated FAA, NASA, Navy effort
   - ADAS
   - COAMPS / NAVDAS

6.2-Nowcast (ONR)

FY01 Milestones:

1. Test and Improve the Nowcast Client/Server System
   - Functionality
   - Stability
   - Automation
   - Documentation

2. Develop Interfaces to Data Streams
   - MORIAH for 5 min data
   - Radar
   - Satellite

3. End-User Interaction (IPT)
   - Subgroups meet Jan / July
   - Virtual IPT on-line to gather feedback on example products

4. Nowcast Product Development
   - ADAS cloud products
   - Static 3D visualizations of satellite and radar data

6.2-Nowcast (ONR)

FY02 and beyond:

- AI data fusion techniques for in-flight icing and turbulence
- Expand radar and satellite data handling capabilities
- Incorporate Autonowcaster
- Expand target area weather capabilities
- Product development in coordination with IPT
- Development of verification and quality assurance techniques
- Collaborative application environment between METOC and warfighters
- 3D interactive visualization and optimal trajectory

Nowcast Plan